Engineering Library

APR 2 1925

The Engineer.

Established 1856. Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C.2.

Vol. CXXXIX.—No. 3615] LONDON: FRIDAY EVENING, APRIL 10, 1925 [Price One Shilling by Inland Post 1s. 3d.

The Engineer

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Railway Results in 1924.

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PUBLIC NOTICES

HEATING.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Tuesday, 28th April, 1925, for the INSTALLATION of ACCELERATED LOW-PRESSURE HOT WATER HEATING at Aytoun-street Employment Exchange, Manchester.

Drawings, specification, a copy of the conditions and form of contract, bills of quantites, forms for Tender, &c., may be obtained from the Contracts Branch, H.M. Office of Works, King Charles-street, London, S.W.1, on payment of One Guinea. (Cheques payable to the COMMISSIONERS of H.M. WORKS, &c.). The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 8874

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E.1, invites TENDERS for :—

1. STEAM-DRIVEN ALTERNATOR SETS, 150 K.V.A.
2. LOCOMOTIVE TANK ENGINES.

Tenders due on the 5th May, 1925.
Tender forms obtainable from above. 8883

Civil Engineers (2) Re- QUIRED by the GOVERNMENT of KENYA COLONY for a tour of 20 to 30 months' service. Salary £400, rising by annual increments of £20 to £500 a year, and thence by annual increments of £25 to £600 a year. Free single quarters or an allowance in lieu. Free passages and liberal leave on full salary. Outfit allowance of £30 on first appointment. Candidates, aged 25-35, must have passed examination to qualify for A.M.I.C.E. or hold equivalent professional qualifications. Must have had not less than two years' experience, either as a pupil or assistant in engineering workshops or upon engineering works or have been employed for a similar period in the engineering profession under a Chartered Civil Engineer. Must have a wide general knowledge, both theoretical and practical, in all branches including mechanical and electrical work.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W.1, quoting M/13,492. 8894

Engineering Draughts- MAN, QUANTITY SURVEYOR, and ARCHITECTURAL DRAUGHTSMAN REQUIRED for the PUBLIC WORKS DEPARTMENT of the GOLD COAST. Salary of all three appointments £480 a year for the first three years of service, then £510, rising to £720 a year by annual increments of £30, and thence rising to £800 a year by annual increments of £40. Outfit allowance of £60 on first appointment. Free passages and quarters and liberal leave on full salary. Candidates should be between the age of 25 and 35.

M/13,464.—ENGINEERING DRAUGHTSMAN.—Candidates should be fully qualified Structural Engineering Draughtsmen, experienced in steel-framed and reinforced concrete structures of all types, such as large public buildings, waterworks, towers and bridges, and should be capable of computing all necessary calculations and preparing stress diagrams.

M/13,465.—ARCHITECTURAL DRAUGHTSMAN.—Candidates must be fully qualified Architectural Draughtsmen, capable of detailing first-class work. Should be members of the R.I.B.A. or the Society of Architects.

M/13,466.—QUANTITY SURVEYOR.—Candidates must have been thoroughly trained in either an Architect's or Builder's Office in building construction in all its details and have then been engaged in a first-class Quantity Surveyor's Office and be thoroughly conversant with taking off, abstracting, billing, estimating, and measuring up.

Apply at once by letter, giving age and brief details of training and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W.1, quoting clearly the reference number of the vacancy applied for. 8861

Royal Corps of Naval CONSTRUCTORS.

A COMPETITIVE EXAMINATION for one or more POSTS as PROBATIONARY ASSISTANT CONSTRUCTOR will be held at the ROYAL NAVAL COLLEGE, GREENWICH, in June next.

The Regulations and full particulars of the salary, prospects of promotion, &c., may be obtained from the SECRETARY (C.E.), Admiralty, S.W.1, to whom intending candidates must submit their names and full particulars of their educational and technical training and practical experience not later than 23rd April.

Preference will be given to ex-Service men.

PRIVATE STUDENTS OF NAVAL ARCHITECTURE.

In conjunction with the above Examination there will be a QUALIFYING EXAMINATION for the admission of PRIVATE STUDENTS of NAVAL ARCHITECTURE to the Royal Naval College, Greenwich. Applications for the Regulations, &c., should be made as in the case of the Examinations for the post of Probationary Assistant Constructors (see above).

Private Students are at present required to pay a fee of £30 a session whilst at the College, but this fee will probably be increased in the near future. 8875

University of Liverpool.

FACULTY OF ENGINEERING.

DEAN: Professor C. O. BANNISTER, M.Eng., Assoc. R.S.M., F.I.C., M. Inst. M.M.

The University awards the Degrees of B.Eng., M.Eng., D.Eng., Ph.D., and a Certificate and Diploma in Engineering.

Degree Candidates must pass an approved Matriculation Examination. Certificate Candidates must submit evidence of having received a good general education. Diploma Candidates must possess the Certificate in Engineering.

The Courses are designed for students desiring to qualify as MECHANICAL, ELECTRICAL, CIVIL or MARINE ENGINEERS, as NAVAL ARCHITECTS and METALLURGISTS or METALLURGICAL ENGINEERS. The Courses cover the subjects of examination for Associate Membership of the Institutions of Civil, Mechanical and Electrical Engineers. The Institutions named, subject to certain conditions, accept the Degree of B.Eng. in lieu of part, and in some cases the whole of the examinations for Associate Membership. The various Departments are housed in commodious and well-equipped buildings, and provide ample facilities for research.

A prospectus of the Faculty, giving particulars of Courses and a large number of Entrance and Post-Graduate Scholarships, may be had on application to the undersigned.

EDWARD CAREY, Registrar.

8883

PUBLIC NOTICES

City of Carlisle.

ELECTRICITY DEPARTMENT.

The Carlisle City Council invite TENDERS for the following :—

STEAM, FEED, BLOW-OFF, and other STEEL PIPE WORK.

Specifications, form of Tender and drawings may be obtained from the undersigned on payment of a deposit of £1 1s. These deposits are repaid after receipt of a bona fide Tender and the return of the specification and drawings.

Tenders, on the prescribed form, must reach the undersigned under sealed cover and endorsed "Tender for Pipe Work," not later than first post on April 27th, 1925.

The Council do not bind themselves to accept the lowest or any Tender.

CHAS. W. SALT, M.I.E.E., City Electrical Engineer.

Electricity Offices, Victoria Viaduct, Carlisle, April 6th, 1925. 8888

County Borough of Blackpool.

The Electricity Committee invite TENDERS for the BORING and CONSTRUCTION of a CABLE SUBWAY, together with the necessary APPROACHES, in either Brickwork or Reinforced Concrete, under the L.M. and S. Railway Embankment opposite the Electricity Works. Approximate length 60 lineal yards.

Drawings and full particulars may be obtained on application to the undersigned.

CHARLES FURNESS, M.I.E.E., Borough Electrical Engineer.

Electricity Offices, West Caroline-street, Blackpool. 8860

County Borough of Salford.

ELECTRICITY DEPARTMENT.
FREDERICK-ROAD POWER STATION.

PLANT FOR DISPOSAL.

ONE Weir TURBINE FEED PUMP, 15,000 galls capacity per hour.
TWO Weir TURBINE FEED PUMPS, 12,500 galls. capacity per hour, suitable for steam pressure of 200 lb. per square inch.
TWO Electrically Driven 3-plunger FEED PUMPS, 4000 gallons capacity per hour each. D.C. motors 440 and 220 volts.
TWO SETS of Lea RECORDING INSTRUMENTS and tanks complete.
TWO Weir CONTACT EXHAUST HEATERS.
TWO Royles' EXHAUST STEAM HEATERS.
STEEL STEAM PIPING, 14in. bore to 6in. bore.
Hopkinson-Ferranti STOP VALVES, 14in. to 6in. bore, all suitable for 200 lb. steam pressure.
CAST IRON VALVES, 4in. bore for boiler-feed piping and other purposes.
CAST IRON BOILER FEED PIPING, 4in. bore.
Also approximately 180ft. of Circulating WATER PIPING, 26in. and 24in. bore with 24in. back pressure valve to suit, and various lengths of Discharge Piping, 34in. 28in., and 22in. bore.

Full particulars and form of Tender may be obtained on application to the Borough Electrical Engineer, Electricity Works, Frederick-road, Salford.

Offers to be received not later than first post on Thursday, the 16th proximo.

L. C. EVANS, Town Clerk.

30th March, 1925. 8832

Offers are Invited for Follow- ing Nearly New GAS ENGINE PLANT :—

ONE 335 B.H.P. Westinghouse Vertical Tandem (2 crank), 4-cylinder, installed 1918, 300 r.p.m. Run only 1700 hours.

ONE 150 B.H.P. Ricardo 6-Cylinder, 1000 r.p.m., installed 1923. Run only 350 hours.

One 150 B.H.P. Ricardo 6-Cylinder, 100 r.p.m. (spare engine).

Please write, ELECTRICAL ENGINEER, Aldershot Gas, Water and District Lighting Co., Lynchford-road, S. Farnborough. 8858

PUBLIC NOTICES

WEST WHARF, CARNWATH-ROAD, FULHAM, S.W. 6

DRY DOCKING, &c., OF PONTOON AND DREDGING WORK.

The Metropolitan Asylums BOARD invite TENDERS for the following WORKS :—

(i.) DRY DOCKING, REPAIRING and PAINTING FLOATING PONTOON and REPAIRING DOLPHINS and SUPPORTING of PIER BROW; and
(ii.) DREDGING WORKS in the Vicinity of the Pontoon.

Specification, conditions of contract and form of Tender for each work may be obtained at the office of the Board, Victoria Embankment, London, E.C. 4. Intending contractors should state, when applying for Tender forms, which work it is proposed to Tender for.

Tenders for each work, addressed as noted on the forms of Tender, must be delivered at the office of the Board not later than 10 a.m. on Wednesday, 22nd April, 1925.

G. A. POWELL, Clerk to the Board.

8903

The South Indian Railway Com- PANY, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

92 TONS STEEL RAILS (B.S., F.B., 60 lb.).

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W.1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Steel Rails," must be left with the undersigned not later than Twelve Noon on Friday, the 24th April, 1925.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 5s. for each copy of the specification.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, of 3, Victoria-street, Westminster, S.W.1.

A. MUIRHEAD, Managing Director.

91, Petty France, S.W.1, 2nd April, 1925. 8860

Urban District Council of GOOLE.

The Goole Urban District Council invite TENDERS for SUPPLYING, ERECTING and SETTING to WORK a STEAM PUMPING PLANT at their new Waterworks Borehole at Pollington Pumping Station near Snaith.

The Plant will consist of a Borehole Pump capable of lifting 56,000 gallons of water per hour from a depth of 200ft. below ground level, and a Force Pump for delivering the same quantity of water to Goole against a total head of 320ft., Two Boilers, an Economiser, an Overhead Traveller, an Electric Lighting Set, and all necessary auxiliary gear.

A preliminary plan of the suggested lay-out, with copies of the conditions of contract and specification, can be obtained on payment of a deposit of £5 (which will be returned on receipt of a bona fide Tender) at the Offices of the Council, Stanhope-street, Goole, or at the Offices of the Consulting Engineer, Mr. E. J. Silcock, M. Inst. C.E., 25, Victoria-street, Westminster, and 10, Park-row, Leeds.

Sealed Tenders, endorsed "Pumping Engines," must be addressed to the Chairman of the Gas and Water Committee, and be delivered at the Council Offices, Goole, not later than the 13th May, 1925.

The Council do not bind themselves to accept the lowest or any Tender.

J. W. PULLON, Clerk to the Council.

Council Offices, Goole, 26th March, 1925 8837

PUBLIC NOTICES

PROPOSED BRIDGE OVER RIVER FORTH AT DRIP, STIRLING.

The County Councils of Stirling and Perth invite DESIGNS, along with TENDERS, for NEW BRIDGE, proposed to be erected over the River Forth at Drip, Stirling. Further details may be obtained from Mr. D. R. Cox, Road Surveyor, Stirling, and Mr. W. L. Gibson, Road Surveyor, Dunblane. Designs and Tenders should be lodged with the subscriber on or before Thursday 30th April next.

The County Councils do not bind themselves to accept any Design or Tender.

JAMES LEARMONTH, County Clerk.

County Buildings, Stirling, 26th March, 1925. 8795

Burma Railways.

ASSISTANT LOCOMOTIVE AND CARRIAGE SUPERINTENDENT.

The Directors will receive APPLICATIONS (by letter only) from properly qualified candidates, who are not less than 23 or more than 26 years of age, and unmarried, for APPOINTMENT in the Locomotive and Carriage Department of the Company in Burma.

Candidates must have had proper theoretical training at a recognised engineering college in Electrical and Mechanical Engineering. They should possess a good knowledge of the theory of A.C. and D.C. motors, and understand station and yard lighting.

Preference will be given to those whose practical training has been obtained with a British Railway or Tramway Company, with experience of Stone's system of train lighting.

SALARY.—Rupees 550, rising by increments of Rs. 50 to Rs. 1100 per calendar month, according to the rules in force.

TERMS.—A three years' agreement in the first instance, first-class free passage to Burma, and home again on satisfactory termination of services.

The selected candidate will be required to pass a strict medical examination before appointment.

Applications, by letter only, giving particulars of age, &c., education, technical training, and practical experience in chronological order (with dates), must be addressed to the undersigned not later than the 24th April, 1925.

SECRETARY, Burma Railways Company, Limited.

199, Gresham House, Old Broad-street, London, E.C. 2, 3rd April, 1925. 8859

Municipality of George Town, PENANG, STRAITS SETTLEMENTS.
ASSISTANT ENGINEER.
ADVERTISEMENT.

The Municipal Commissioners of George Town, Penang, REQUIRE an ASSISTANT ENGINEER, age 25 to 32, preferably unmarried, on a three years' agreement with possible extension. Applicants must have had a good technical education and a regular training as pupil and assistant in a Municipal or County Engineer's Office, with experience in municipal and general engineering work, including Roads, Buildings, Bridges, Sewerage and Conservancy details, and the control of workmen. Preference will be given to candidates who have a knowledge of the design of Sewage Works and who have passed the Testamur Examination of the Institution of Municipal and County Engineers.

Salary 5400 dollars for the first year, rising, if the officer remains in the service, by biennial increments of 300 dollars a year to a maximum of 9000 dollars per annum, paid monthly in dollars, the currency of the Colony, the value of the dollar being 2s. 4d. sterling. The pay of the appointment at this rate for the first year would be £630. An allowance for the maintenance of a motor car when on duty will be granted. Free passage will be provided, with half pay during the voyage out. The selected candidate must pass an approved medical examination.

Applications, stating whether married or single, age, birthplace, and giving details of education, training and experience generally, with particular reference to the items mentioned above, and copies (only) of testimonials, to be lodged with Messrs. PEIRCE and WILLIAMS, MM. Inst. C.E., 180, Hope-street, Glasgow, Agents for the Commissioners (who will give further particulars if requested), not later than Tuesday, 21st April, 1925. 8892

Manchester Corporation Water- WORKS.
HAWESWATER SCHEME.

The Waterworks Committee REQUIRE the SERVICES of SEVERAL CIVIL ENGINEERING ASSISTANTS (three grades).

Application forms, which can be obtained from the SECRETARY, Waterworks Offices, Town Hall Manchester, must be delivered not later than the first post on the 27th April, 1925. 8854

SITUATIONS OPEN

WANTED, an Energetic Up-to-date ASSISTANT for WORKS MANAGER. Must be good disciplinarian, familiar with latest and best machine shop practice, and able to reduce costs of manufacture. Write, stating experience and salary expected. Good opening for right man.—Address, 8890, The Engineer Office. 8890 A

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SITUATIONS OPEN (continued)

WANTED, ASSISTANT CIVIL ENGINEER for contract in France, speaking and writing French fluently.—State qualifications, experience and salary, H. T. JENKINS and SON, Ltd., Torquay. 8812 A

WANTED by Old-established Tube Company, First-class SALESMAN with connection, to represent Lancashire and adjacent counties. Good position offered to suitable man. First-class references required. State salary or commission.—Address, 8887, The Engineer Office. 8887 A

WANTED (Midlands), ENGINEER WORKS MANAGER'S ASSISTANT. Age about 31 to 34, usual educational, technical and personal qualifications are necessary.—Address, 8902, The Engineer Office. 8902 A

BLUE PRINTING.—MAN to Take Charge of Manufacturing Engineers Blue Print Room and Drawing Files. Must have knowledge of Rotary Blue Printing Machines and modern Photostatic and Reproduction Processes, together with experience of Routine Filing and Card Indexing.—Address, stating age, experience and salary required, 8742, The Engineer Office. 8742 A

ENGINEER (Outside Structural Supervisor) REQUIRED, capable organising rapid erection of large contract. State age, experience, and salary.—Address, 8867, The Engineer Office. 8867 A

GENERAL ENGINEERING WORKS, CEYLON, REQUIRE capable ASSISTANT ENGINEER, single, 26-30, must have served regular apprenticeship and possess indentures, must be a first-class general Turner and Fitter, with charge experience of responsible outside erection of Steel-framed Factories, Engines, Plant and Millwrights' Work, Land and Marine Engine Repairs; must hold technical qualifications with responsible experience in drawing and estimating office; must be a good designer, capable of training native draughtsmen and mechanics, interviewing clients, securing orders with connected correspondence and reports. Commencing salary Rs. 550 per month. All applicants must state complete details of technical training and practical experience, giving dates, with copies of references since leaving school.—Address, 8857, The Engineer Office. 8857 A

GRINDING MACHINE DEMONSTRATOR.—WE WANTED, DEMONSTRATOR SALESMAN, thoroughly conversant with modern Cylindrical Grinding Machines, external and internal, to assist large sales force in selling in Great Britain two very well-known makes of these machines.—Address, with full particulars age, education, training and experience, 8877, The Engineer Office. 8877 A

REQUIRED, ASSISTANT ENGINEER as Instrument Man for Railway Survey in Africa.—Apply by letter, with references, to PAULING and CO., Ltd., 26, Victoria-street, London. 8866 A

NIGERIA.—JUNIOR ENGINEER for Cold Storage and Icemaking Plants; experience with Ammonia Compression Plant, Gas Engines and Producers and Electric Motors is essential. Full particulars of experience and age.—Box G57, Lee and Nightingale, Advt. Offices, Liverpool. P482 A

STRUCTURAL STEEL WORK ENGINEER.—Experienced MAN REQUIRED; must be thoroughly used to estimating on competitive lines and designing all kinds of Steel Work, Corrugated Steel-framed Buildings, and capable of dealing with correspondence and taking complete charge of works employing 50 to 60 men.—Replies, marked "Private," stating fully experience, age, and wages required, to WILFRED ROBBINS, Ltd., Golds Hill Ironworks, Great Bridge, Staffs. P481 A

YOUNG MAN, with Good Engineering and Literary abilities, REQUIRED to Superintend Advertising, &c. Must have sound knowledge of Gearing. State age, salary required, and previous experience.—DAVID BROWN and SONS (Huddfd.), Ltd., Lockwood, Huddersfield. 8880 A

WANTED for Aircraft Work, by S. E. SAUNDERS, Ltd., of Cowes, AERONAUTICAL or First-class LIGHT MECHANICAL DRAUGHTSMEN.—Apply, giving full particulars of experience and salary anticipated. Vacancies exist for 3 or 4 good men. 8867 A

A LEADING FIRM of BANKERS' ENGINEERS REQUIRE the SERVICES of TWO Competent DRAUGHTSMEN, one experienced in Steel Office Furniture and the other in Reinforced Concrete. Give full particulars of experience, age and salary expected.—Address, 8881, The Engineer Office. 8881 A

DRAUGHTSMEN.—BEFORE NEGOTIATING with Government Departments in connection with any post, PLEASE COMMUNICATE with the GENERAL SECRETARY, Association of Engineering and Shipbuilding Draughtsmen, 96, St. George's-square, London, S.W. 1. 8768 A

DRAUGHTSMAN REQUIRED, with Experience in Small Mechanical Apparatus; electrical experience an advantage, but not essential. Acton district. State age, experience, and salary required.—Address, 8870, The Engineer Office. 8870 A

DRAUGHTSMEN WANTED by Firm of Westminster Engineers. Must have thorough knowledge and experience of works in connection with Dock, Harbour and large Public Works Contracts.—Apply, giving full particulars of age, experience, and salary required, to Box 547, c/o Brown's, Tothill-street, Westminster, S.W. 1. 8814 A

DRAUGHTSMAN, with All-round Experience of Construction of Water-wheel Alternators, REQUIRED by Old-established Firm.—Address, with full particulars of experience and salary required, to 8820, The Engineer Office. 8820 A

HEAD DRAUGHTSMAN for Structural Works, Glasgow district; must have sound theoretical and practical experience; age between 30 and 40; salary about £500 or over, according to qualifications.—Address, with full particulars, P442, The Engineer Office. P442 A

LARGE FIRM of GASWORKS PLANT MANUFACTURERS REQUIRE the SERVICES of TWO experienced and responsible DRAUGHTSMEN, used to Gasworks and Chemical Plant. Full details of experience, connection, salary required, &c.—Address, 8897, The Engineer Office. 8897 A

MECHANICAL and GENERAL ENGINEERING DRAUGHTSMAN REQUIRED, to Prepare Detail Drawings and Schemes in drawing-office of large manufacturing works in the Midlands. The following training is essential:—At least two years day student in recognised college or university diploma or engineering degree, and three years in workshop of well-known firm of general engineers. At least three years' drawing-office experience.—Address in confidence, stating age, training, experience, salary required, and when at liberty, 8856, The Engineer Office. 8856 A

REQUIRED IMMEDIATELY, THREE ENGINEERING DRAUGHTSMEN, with thorough knowledge of and experience in the design of Heating and Ventilating Installations, Domestic Hot Water Apparatus, and preferably also Vacuum Cleaning Plant.

Candidates must have served in H.M. Forces during the war.

Applications, in writing, to "W. Y.," c/o Charles Barker and Sons, Ltd., 31, Budge-row, E.C. 4, not later than 18th April, with not more than three copies of recent testimonials and full particulars of qualifications, practical experience, war service, age, and salary required. 8873 A

REQUIRED (London), DRAUGHTSMAN, Experienced Water-tube Boilers and Boiler-house layout. State experience, age, and salary required.—Address, P466, The Engineer Office. P466 A

SITUATIONS OPEN (continued)

WORKS FOREMAN REQUIRED, East Midlands, with Pumping Machinery experience, used to accurate heavy work with general purpose machines, and capable organiser. State experience, salary, and when disengaged.—Address, 8900, The Engineer Office. 8900 A

SITUATIONS WANTED

CIVIL ENGINEER (28), B.Sc. (Edinburgh), A.M.I.C.E., 4½ years' experience irrigation works in East, SEEKS POSITION at home or abroad. War service and highest references.—Address, P480, The Engineer Office. P480 B

ENGINEER (27), Articled Pupil 3 Years, 4 Years' war service, refrigeration, laboratory, drawing-office and production experience, also 15 months at sea, DESIRES POSITION as ASSIST. WORKS MANAGER or on commercial side.—Address, P483, The Engineer Office. P483 B

ENGINEER (32) SEEKS Assistant Works Manager's or any Works Executive POSITION with scope. Shop production experience, charge tool, design, planning, practical; London district preferred.—Address, P476, The Engineer Office. P476 B

EXPERIENCED ENGINEER, with Public School education, university training, energetic, with organising ability and commercial and executive experience as managing director large public company, returned from abroad, DESIRES good APPOINTMENT.—Address, P485, The Engineer Office. P485 B

RESIDENT ENGINEER, POSITION as, WANTED AT ONCE. Parliamentary work, contract plans, construction of railways, bridges, tunnels, roads, &c., estimating and costs.—Address, P468, The Engineer Office. P468 B

PARTNERSHIPS

IF YOU ARE SEEKING

A PARTNER or PARTNERSHIP

or wish to buy or sell a

BUSINESS or WORKS

Write:

WHEATLEY KIRK, PRICE & CO.,

46, Watling Street,

London, E.C. 4.

Established over 70 years.

ENGINEER, Wide Experience Manufacturing and selling, with influential connections, DESIRES INTEREST in sound SMALL CONCERN in Midlands; some capital available.—Principals, solicitors or accountants please communicate with FOSTER, PETTITT and SIMCOX, Solicitors, 13, Bennett's-hill, Birmingham. 8862 C

EDUCATIONAL

CORRESPONDENCE COURSES for Inst. C.E., Inst. Mech. E., London Univ. (Matric., Inter., B.Sc.), and ALL ENGINEERING EXAMINATIONS, personally conducted by Mr TREVOR W PHILLIPS, B.Sc. (Honours) Eng., London, Assoc. M. Inst. C.E., Chartered Civil Engineer, M.E.S.I., F.R.S.A., &c. Also Day Tuition in Office. Excellent results at all Exams., comprising hundreds of Successes. Courses may commence at any time.—Apply to Mr. TREVOR W. PHILLIPS, B.Sc. (Hons.), A.M.I.C.E. &c. 8/11, TRAFFORD CHAMBERS, 68, SOUTH JOHN-STREET LIVERPOOL. Ex. B

SURVEYING AND LEVELLING. — EXCELLENT OPPORTUNITY to ACQUIRE thorough practical INSTRUCTION on WORK. — Address, E. MOUL, Hollybank, Woking. P179 B

TUITION BY POST.—Inst. C.E. and I. Mech. E. Enrol now for next Exams.; 100 per cent. passes last examination. Reinforced Concrete, new comprehensive course under expert engineer, £3 3s. Write for particulars.—PENNINGTONS, University Tutors, 254, Oxford-road, Manchester. Estab. 1876. Ex.

TUITION BY CORRESPONDENCE.

Expert tuition in Mathematics, Mechanics, Machine Construction and Drawing, and for B.Sc. (Engineering) and other examinations.

Mr. J CHARLESTON, B.A.

(Hons. Oxon & Lond.).

14, Elsham Road, Kensington, London, W. 14.

AGENCIES

CHARTERED ENGINEER (Civil, Mech., and Electrical), practical man, with office in Westminster, first-class acquaintance with rly. technical and traffic officers, DESIRES to REPRESENT FIRM, preferably in connection with "Electrification."—Address, P366, The Engineer Office. P366 D

CHARTERED PATENT AGENT DESIRES POSITION on Technical Staff of Large Engineering Firm, to act as adviser and agent in patent matters; moderate salary required.—Write, Box 5631, c/o Judds, 87, Gresham-street, E.C. 8855 D

FOR HIRE

FOR HIRE, PUMPS and WELL-BORING TOOLS for Contractors' Deep Wells, &c., 2in. to 24in. dia.—E. RICHARDS and CO., Upper Ground-street, London, S.E. Telephone No. 978 Hop. 822 E

FOR SALE or HIRE, ELECTRIC MOTORS, from 60 to 800 H.P.; PORTABLE STEAM ENGINES, from 8 to 40 N.H.P.; STEAM BOILERS, CRANES, PUMPS, MACHINE TOOLS of every description; reasonable terms, immediate delivery.—J. T WILLIAMS and SONS, 37, Queen Victoria-street, London, E.C. Tel., City 3938. Ex.

MACHINERY, &c., WANTED.

WANTED, About SIX 10in. Centre and TWENTY 8in. Centre Strong LATHES, 3ft. between centres, second-hand, in good condition.—Address, 8864, The Engineer Office. 8864 F

WANTED FOR EXPORT.—ONE 12/14ft. and ONE 5/6ft. VERTICAL BORING MILL.

ONE KEYSEATING MACHINE, with tilting table, to cut 2in. keyways.

ONE SHAFTING LATHE, to admit 35ft. long and swing 36in. diameter over shears.

ONE BOLT HEADING MACHINE, to make up to 2in. bolts.

ONE 3-TON STEAM HAMMER.

Address full particulars and prices in first instance to 8889, The Engineer Office. 8889 F

WANTED, NEW or SECOND-HAND MOTOR, about 400 B.H.P., 400/440 volts, three phase, 50 periods, 245 revs. per minute.—Address, 8729, The Engineer Office. 8729 F

KEARNS' or RICHARDS' MACHINES WANTED, Nos. 3 or 4, must be in new condition. State price, date of manufacture, and where can be seen.—Address, 8890, The Engineer Office. 8890 F

PATENTS

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United States of America, Patent No. 1,514,299, Nov. 4th, 1924. Canada, do., 233,898, Aug. 28th, 1923. Union of South Africa, do., 233/1923, March 7th, 1923. Belgium, do., 308,807, Feb. 13th, 1923. France, do., 562,152, Feb. 14th, 1923. Germany, Design do., 859,301, Feb. 15th, 1923. Japan, Pending.

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For continuation of For Sale Advertisements see page 3.

A Seven-Day Journal

Houses of Pressed Cork.

At Betteshanger, near Deal, where the Pearson and Dorman Long colliery is situated, two houses of a new form are now being built, and are being inspected this week by various Government departments. The framework is of steel, manufactured at Middlesbrough, and none of its members, it is stated, exceeds 2¾ cwt. in weight. To it are attached slabs of compressed cork 2in. or 4in. thick. Externally the cork and framework is protected from the weather by a coating of concrete 1¼in. thick, applied to a reinforcing basis by means of a cement gun. It is stated that the cork walls are non-inflammable, are largely soundproof and act as heat insulators to an extent which, it is estimated, will save some 25 per cent. of the fuel used for heating purposes. It cannot be denied that some of the all-steel houses that have recently been built are unsightly externally, and that efforts made to imitate a normal appearance generally end in accentuating the unpleasing impression. The Betteshanger houses are, however, or ought to be, in a different category in this respect, for their external appearance should closely resemble that of an ordinary house, and, moreover, is conveyed by a familiar material applied, not as a sham, but as an essential part of the structure. That the all-steel house does not represent the final word in alternative methods of house construction would seem certain. Inventiveness in other directions is being continually manifested. In this connection we notice that the Building Research Board is about to enlarge its facilities for investigating new house building methods by the acquisition of an old country house near Watford, which will provide ample accommodation for laboratories and the conduct of research work generally.

A Mining Offer Rejected.

The experiment undertaken by the miners at the Vauxhall Colliery near Wrexham in North Wales is said to be developing satisfactorily, although the action of the men in taking over the pit and running it for an experimental period of three months with an indemnity to the owners against any loss has led to a recommendation by the executive of the North Wales Miners' Association that the Vauxhall men should be expelled for a period from the union. At the Wirrall Colliery, Cheshire, a similar arrangement was discussed between the management and the representatives of the North Wales Association. The management offered to hand over the pit to the men for a period of nine months, any profit made to be retained by the men and any loss to be met by them. The negotiations, however, broke down, the union representatives deciding to reject the offer. The pit, it would appear, is therefore to remain closed and the machinery is to be dismantled. We gather that the union representatives were chiefly concerned about the possibility of a loss being made, which they would have to make good to the management. At any rate, it is stated that a new seam has been struck at the colliery, and that in consequence of that fact negotiations may be reopened with the result that after all the men may agree to accept the offer.

The Southampton Channel.

On his arrival at Southampton on Saturday on the White Star liner Olympic, Mr. P. A. Franklin, the president of the International Mercantile Marine Company, inspected the Majestic lying in dry dock, and complimented the authorities on the addition of the dock to the facilities of the port. He reminded them, however, that the question of constructing a straight channel across the Brambles, which would give liners a straight run in and out of the port, was one which should not escape attention. If this channel were to be constructed, Mr. Franklin appeared to think that Southampton need fear little from the improved docks accommodation either at Tilbury or Liverpool. The large liners, he said, were first diverted south to Southampton owing to the close proximity to Cherbourg and other parts of the Continent, and he did not think that Liverpool's dock developments, although they might attract a particular type of ship, would be such as to attract the larger ships from Southampton Harbour.

Railway Development in Nottinghamshire.

Both the London and North-Eastern Railway and the London, Midland and Scottish have been seeking parliamentary powers for the construction of new railways in Nottinghamshire in order to provide a through route between Nottingham and Retford, and accommodate a great development of the coal mining industry in the county. While the London and North-Eastern scheme covers the construction of a large amount of new railway, the London, Midland and Scottish proposes to secure much the same end by means of connections and loops on the existing railways in the neighbourhood. The two schemes are more or less competitive and were submitted together to a Committee of the House of Lords. On Friday of last week the counsel for the companies intimated that their clients had since the previous meeting of the Committee been in conference together, with the result that it was found that the two schemes, having been conceived independently, could not be joined in one. The companies agreed, however, to ask leave to withdraw their respective Bills in order that in the next parliamentary session they might be free to advance a single new scheme for a joint railway.

Mr. S. L. Pearce and the Electricity Commissioners.

The Manchester Corporation has agreed to the resolution of the Electricity Committee recommending that Mr. Pearce, the chief engineer and manager of the Corporation Electricity Department, should be allowed to assist the Electricity Commissioners in their work of reviewing and checking a national scheme of electricity supply. This appointment is the outcome of a letter which the Committee received from Sir John Snell, the Chairman of the Electricity Commission, asking for Mr. Pearce's assistance. The work will involve one day's occupation per week, and the Manchester Corporation has reason to feel some degree of pride in the choice of its chief engineer for such an extremely important position. Mr. Pearce has only recently returned from a trip to Australia, where he went last autumn to advise the Sydney Corporation with regard to its electrical affairs. Under Mr. Pearce's administration the Manchester electricity undertaking has made remarkable progress, and the new power station at Barton is quite the "last word" in this branch of engineering.

German Contracts.

In an important letter to *The Times* last week, Sir Philip Dawson dealt with the orders for ships recently placed in Germany. The causes which enabled the Deutsche Werft to quote such a low price, he contended, were not mainly longer hours and lower wages than those prevailing in this country, but the fact that since the war the firm in question had designed and installed plant for the special purpose of producing definite types of ships. Moreover, the management was very able and had special knowledge of motor-propelled vessels. The yard, the letter continued, co-operated with manufacturing engineers who were experts in the production of Diesel engines on a large scale, and with those who produced all the component parts from the raw material upwards. Recently, Sir Philip stated, he saw a German works in which the installation of modern plant had increased the output, whilst the number of men had been reduced from 1050 to 750. Germany, with its great industrial combinations working in close co-operation with its banks, and supported by the active intervention of its Government, had, Sir Philip continued, put British industry in the position of having to wage a most unequal contest. German banks owned large blocks of shares in German industry, and were therefore directly interested in its prosperity. They had financed new enterprises, thus creating markets for the German manufacturer. New methods, Sir Philip argued, must be adopted if our present difficulties are to be overcome.

Rejected Tramway Extension Scheme.

A Standing Committee of the House of Commons, presided over by Major Malone, recently rejected the application of the London County Council for powers to construct 5 miles of new tramway to connect existing lines at Well Hall-road, near the Woolwich housing estate, and at Bromley-road, near the Downham and Bellingham estates. One of the reasons given for rejecting the scheme was that the Committee considered it premature. Strong opposition to the proposal was put forward by Mr. Frank Pick, assistant general manager of the London General Omnibus Company, who pointed out that part of the proposed tramway was intended to run over an arterial road. The arterial roads, he said, were being constructed from the proceeds of the taxes paid by motor vehicle owners, who were promised that the money would be used for their benefit, and his company, which paid £391,670 to the Road Fund last year, was not pleased to find that a proposal had been put forward to use an arterial road for tramways. The area proposed to be covered by the new tramway was already adequately served by motor omnibuses. The more speedy movement of traffic in and out of London was the purpose of arterial roads, rather than their mere capacity, and speed would be much reduced if tramways were placed on the roads.

Non-Ferrous Metals Research Association.

At the annual luncheon of the British Non-Ferrous Metals Research Association, which was held in London on Friday last, the new arrangement of financial support from the Government was explained by Mr. Thomas Bolton, the chairman. Up to the present the Association has received a grant, through the Department of Scientific and Industrial Research, representing half the expenditure. It has, however, been decided that the Association must become self-supporting, and to this end the Government has made an offer of £24,000 during the next five years, contingent on the Association's raising in subscriptions from the industries concerned, in the same period, a sum of £56,000. The Government grant would start at a maximum of £8000 a year and would diminish each year by 20 per cent. of that amount, so that subscriptions would have to increase to a corresponding extent. At the end of five years, assuming that the subscriptions were doubled, the Association would be self-supporting. The new scheme is not, however, to apply to certain sections of the industry, such as galvanising, brassfounding and lead, which are to continue on the old basis. At the same meeting Engineer Vice-Admiral Sir Robert Dixon said that during the recent voyage round the world of the Special Reserve Squadron the seven ships covered some 40,000 miles in ten months. Steam was kept up all the time and one or more condensers in every ship was always in use. The condensers contained in all 163,000 tubes, but only five tubes gave out, three in one ship and two in another, a result reflecting great credit on the manufacturers and on the Admiralty specification and system of inspection.

The Zambesi Bridge.

It is reported that the Portuguese Minister for the Colonies has sanctioned the construction of the proposed bridge across the river Zambesi at Sena in Portuguese East Africa. This bridge, for which plans have already been prepared, is estimated to cost £800,000 and will connect the Trans-Zambesia and Central African Railways and complete the through railway route from Beira to Nyasaland. It is anticipated that in the course of a few years the traffic from certain coal mines now being developed will yield sufficient return to meet the interest charge on the cost of the bridge, but in the meanwhile some financial assistance will be required, and it is hoped that in view of the importance of the bridge to Nyasaland and North-Eastern Rhodesia such assistance will be forthcoming from the Imperial Government. It is believed that the construction of the bridge and the development of the coal traffic will result in a general reduction of rates sufficient to encourage a large extension of the cotton growing industry of the district served.

A New Motor Ship.

The Raby Castle, a single-screw motor ship, which was built to the order of the Lancashire Shipping Company—J. Chambers and Co., Liverpool—by the Caledon Shipbuilding and Engineering Company, of Dundee, and which is engined with an eight-cylinder North-Eastern Werkspoor motor, is a vessel of more than usual interest. She is not large, for her gross tonnage is about 4900 tons, with an overall length of 412ft. 9in., a breadth of 52ft. 3in., and a depth of 37ft., but her machinery is notable on account of the new design of column construction and the fact that the engine is the largest of the type yet installed in a single-screw ship. The main motor is designed for a normal output of 2200 brake horse-power or 3000 indicated horse-power, at a speed of 92 revolutions per minute. The eight cylinders each have a bore of 28¾in. and a stroke of 4ft. $3^{3}/_{16}$in. All auxiliaries are electrically driven with the exception of a small steam boiler, which will be used for emergency starting only. The ship underwent successful trials off the Tyne on Tuesday and Wednesday last, and will take up her work—which eventually will be between New York and the Far East—early next week. In a subsequent issue we hope to give some further particulars of the vessel and of her propelling and auxiliary machinery.

German Engineering Competition.

It is reported from Capetown that orders have been placed by the South African Railways for twenty-one locomotives to be built in Germany at prices 33⅓ per cent. below the figure quoted in the lowest British tender. It is believed that further extensive railway orders may shortly be placed in Germany by the South African authorities. As an explanation of the success of the Germans in this matter, it is suggested that the standard of living among the German workers in the locomotive industry is very much lower than that of those engaged in similar work in this country. The placing of certain contracts in Great Britain by the late South African Government is said to be explained by the fact that the British firms concerned were in a position to guarantee prompt delivery. In the textile machinery industry, it would seem, intense competition from Germany is also to be expected. Krupps, it is reported, are now manufacturing a wide range of machinery for the cotton, woollen and worsted industries, and are taking very active steps to introduce their products into the United States and other countries. The firm, it is said, is specialising in flat-carding engines, drawing frames, intermediate frames, ring spinning frames, callenders, baling presses and so forth, all driven individually by electric motor, a method of operation which is not very popular in Lancashire.

The British Steam Railway Locomotive from 1825 to 1924.

By E. L. AHRONS, M.I. Mech. E.

No. XV.*

PERIOD 1849 TO 1855 (*continued*).

Bristol and Exeter Railway, Broad Gauge Double Bogie Express Tank Engines.—In his evidence before the Gauge Commission in 1845, Benjamin Cubitt, then locomotive superintendent of the Brighton, Croydon and Dover Joint Committee, made the following statement :—

"I think the driving wheels may soon get too high for safety, except you have plenty of other wheels to keep on the road with. You may get the driving wheels of any height . . . if there are ten wheels, it would perhaps be all the better. Two fours on bogie frames and a pair of drivers would be a very safe carriage." [1]

Whether J. Pearson, locomotive superintendent of the Bristol and Exeter Railway, was inspired or influenced by Cubitt's suggestion is not known, but he certainly designed the 4–2–4 express tank engines, eight of which were built by Rothwell, of Bolton, in 1853–4, and in their original condition are illustrated in Fig. 102. They may certainly claim to have been the boldest departure made up to that time from the accepted canons of locomotive design, other than perhaps Trevithick's "Cornwall" and Crampton's "Liverpool." Some sectional illustrations of these engines as built in 1853—not 1868, as stated—were given in The Engineer Supplement, December 16th, 1910, page vi. But no description of them, beyond the meagre details in Colburn's "Locomotive Engineering," page 73, has ever been given, and therefore the following account of their constructional details may be of interest.

The cylinders were 16½in. by 24in.; driving wheels (flangeless), 9ft. diameter; bogie wheels, 4ft. diameter; wheel base, 5ft. 9in. + 6ft. 7½in. + 6ft. 7½in. + 5ft. 9in. = 24ft. 9in. The boiler was of small size for a broad-gauge engine, the barrel being 10ft. 9in. long by 4ft. 0½in. inside diameter, with 180 tubes $1^{15}/_{16}$in. diameter. The writer can find no record of the heating surface and boiler pressure. Colburn gave the weight loaded as 42 tons, presumably with the tanks full. It may be noted that the wheel base shows a symmetrical arrangement, in spite of which the engines are stated by Colburn to have run with great steadiness. There were several peculiarities of design. The smoke-box was extremely short and the cylinders projected outside about 1ft. towards the front. The inside plate frame extended from the front buffer beam to the front of the fire-box, and was only 8in. deep for the greater part of its length except at the driving hornblocks. An arrangement of angle plates, 2ft. deep, was fastened to the side of the fire-box and to the front of the well tank. From this point to the back buffer beam there was no frame at all. The inside bearings were only 5in. long, and therefore additional outside bearings, 9in. long, were provided, the hornblocks of which were riveted to the triangular queen truss "frame," shown outside the driving wheel in the illustration. This outside frame was, in turn, riveted to an angle iron at the back of the platform, a very light form of attachment. To avoid transmitting the load through this frame to the platform, a special and unique form of spring gear—Fig. 103—was adopted. Both inside and outside springs each consisted of four india-rubber discs separated by plates and enclosed within a casing, which in the outside spring was solid with the long spring pillar, and in the inside spring was riveted to a flat foot forged on the pillar. The inside pillar was 2ft. 10in. long, and the outside one 2ft. 4½in. long from the top of the rubber spring to the eye for the lever. At the bottom they were widened out to 3in. diameter, and made hollow to take the 1½in. spindles, which by their vertical movements inside the pillars compressed the springs. The top portion of the inside spindle tapered from 2in. to 1½in. diameter, and that of the outside one, which bore the greater load, tapered from 2½in. to 2in. diameter. The spindles appear weak in that they were long thin columns under compression. At the top the inside and outside spindles were connected by a double-armed lever, the length of the inside arm being 8½in., and that of the outside arm 7½in., to equalise the spring pressures on each side of the fulcrum. The fulcra on the two sides of the engine were fixed in a heavy saddle bracket, which was riveted to and spanned the boiler. The boiler itself was rigidly fixed to the inside frames by means of the large brackets shown in Fig. 102, and therefore the spring borne load was transmitted between the springs and the inside frames through the boiler.

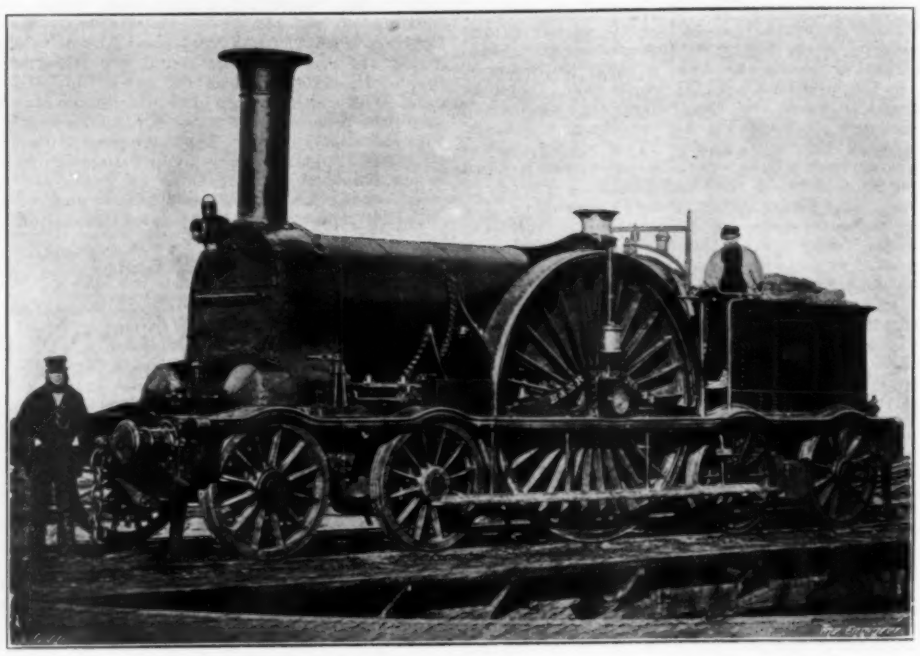


FIG. 102—PEARSON'S ENGINE FOR THE BRISTOL AND EXETER RAILWAY, 1853

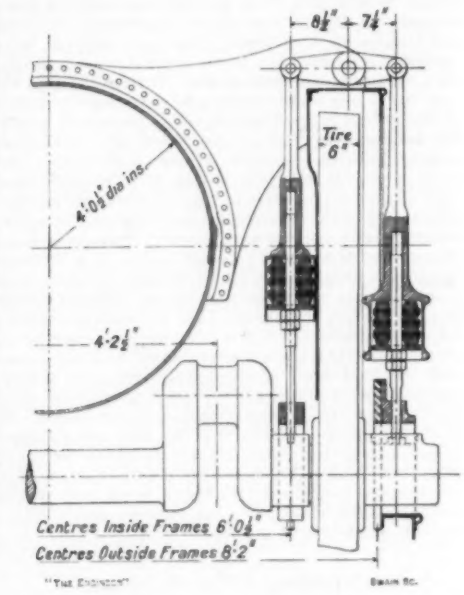


FIG. 103—SPRING GEAR, BRISTOL AND EXETER RAILWAY

Each bogie wheel had an independent india-rubber spring. The bogies were of the Gooch ball-and-socket type, without lateral play, but their wheel base was somewhat longer than in Gooch's bogies. The ball of the leading bogie was secured to the underside of the cylinders by means of a casting with wings, to which two horizontal tie rods were fastened; the other ends of the latter were secured to the bogie side frames, and prevented the bogies from slewing round across the track. In the absence of main frames at the trailing end, the ball pivot of the trailing bogie was simply riveted by means of a plate in the form of a cross, to the underside of the tank. No tie check rods were provided at this end. Brake blocks worked by a screw from the footplate were provided between the wheels of this bogie.

The history of these remarkable engines has never been correctly recorded. In 1868–73, after an average life of about sixteen years, all the eight original Rothwell engines were scrapped, a fact which shows that they left something to be desired. Four new engines—Fig. 104—in which practically nothing of the originals remained, were built at Bristol in their place.

The differences in design are of considerable interest. The old 16½in. by 24in. cylinders, spaced at 4ft. 2½in. centres, gave place to 18in. by 24in. cylinders at 3ft. 6in. centres, thus involving new crank axles. The diameter of the driving wheels, which had flangeless tires, was reduced from 9ft. to 8ft. 10in., and the centres were new. The bogies also were new, and the wheel base of each was 3in. shorter. The diagrams—Fig. 105—show the two wheel arrangements, and it will be noticed that instead of the original symmetrical wheel base, the driving wheels were nearer to the leading than to the trailing bogie. The coal bunker and tank were shorter but deeper. It is an interesting, though doubtful, speculation whether the symmetrical wheel base of the old engines had produced unsteady running, and whether the alterations may have been partly due to this cause. On the other hand, the boiler and fire-box casing were about 11in. longer in the new engines, and a redistribution of weight was probably the primary cause

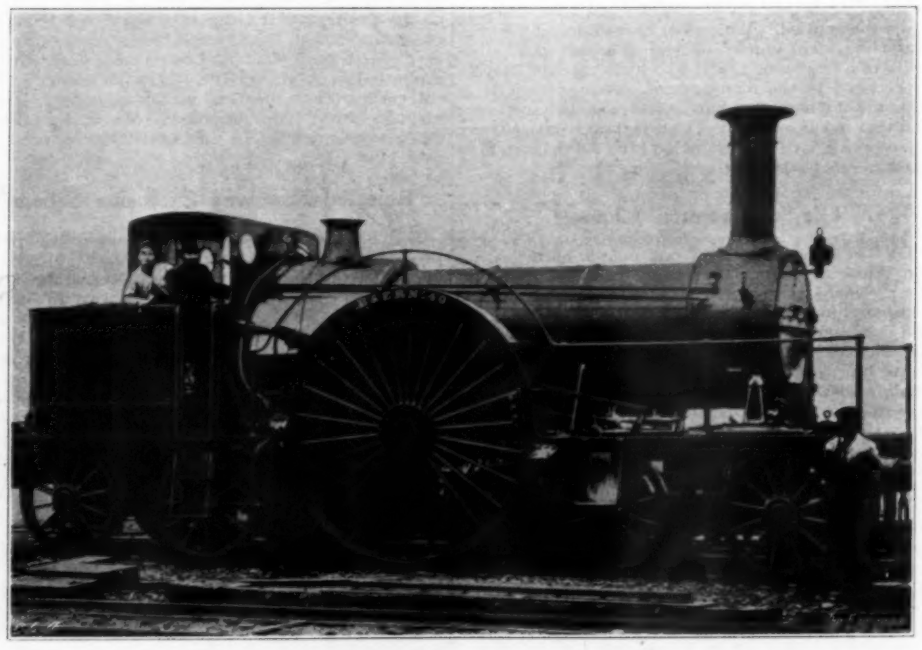


FIG. 104—PEARSON'S ENGINE FOR THE BRISTOL AND EXETER RAILWAY, 1868

* No. XIV. appeared April 4th.

[1] Gauge Commission, Question 1512, page 93.

of the modification. The framing was entirely new; the old outside bearings and complicated spring gear, with india-rubber springs, were discarded, and a new simple inside plate frame extending from front to back buffer beam was used with plate springs above the driving axle. The new bogies had independent elliptical plate springs below each axle, and all the bogie wheels were braked. The smoke-box was lengthened and enclosed the cylinders completely. The fire-box casing was raised above the barrel, whereas in the old engines it had been flush. The new boilers had a tube heating surface of 1088 square feet; fire-box was 147 square feet; total, 1235 square feet; grate area, 23.1 square feet; the weight in working order was 15 tons 8 cwt. on the leading bogie, 18 tons 10 cwt. on the driving wheels, and 15 tons 16 cwt. on the trailing bogie, total 49 tons 14 cwt.

The fire-box was provided with transverse water tubes, and another interesting detail was an arrangement whereby the blower in the chimney was opened automatically by the closing of the regulator. Some drawings of the later new engines, with details, were given in THE ENGINEER, May 9th, 1890, to which reference may be made.

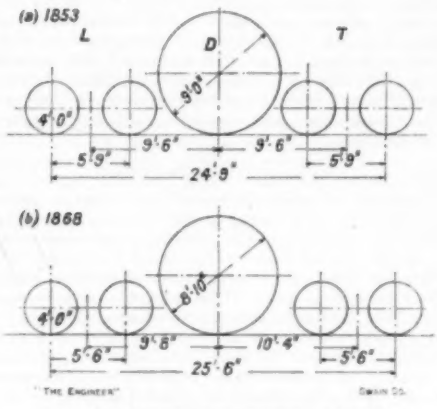


FIG. 105—BRISTOL AND EXETER RAILWAY

The great weight, 18¼ tons, on the driving wheels, which were without counterweights, is worth noting. In July, 1876, one of these engines, when working the up Flying Dutchman, ran off the rails near Bourton, the cause being defective permanent way. After this accident, their career as tank engines ended, and the Great Western, into whose hands the Bristol and Exeter Railway had passed, converted them into 4–2–2 tender engines, the trailing bogie being replaced by a single axle with 4ft. 6in. wheels under the footplate. The driving wheels were reduced to 8ft. diameter, and the weight on them was also reduced. In this form two of them ran until the abolition of the broad gauge in May, 1892.

There were two somewhat similar 4–2–4 tank engines with 7ft. 6in. wheels, one of which, G.W.R. 2005, built in 1862, remained in its original condition until broken up about 1887.

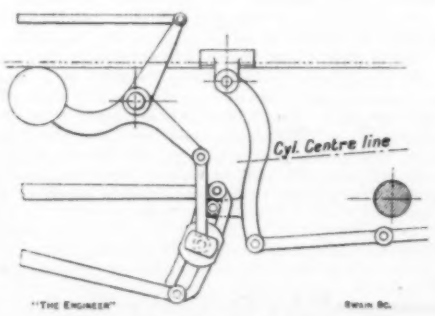


FIG. 106—VALVE GEAR, 1846 TO 1852

MISCELLANEOUS DETAILS OF CONSTRUCTION, 1846 TO 1855.

A number of details have been mentioned in the foregoing descriptions of particular engines, and therefore under this heading it will be necessary to refer only to additional items.

The inconvenient general design of goods engine with inside cylinders inclined upwards and slide bars beneath the leading axle held its own until the end of 1850, when it was finally discarded. It would probably have been given up before had not the best arrangement of inside cylinders with common steam chest between them been patented, by R. Stephenson and Co., in 1841, and in preference to paying royalty, some engineers gave the running shed staffs extra work in having to take down the slide bars, connecting-rods, and the whole of the motion when the engine had to be lifted to repair the axle-boxes. On the other hand, this inconvenient design allowed the boiler to be placed lower in the frames than when the valves were above, and there appears also to have been an additional reason in that Stephenson's inside steam chest was then thought to be suitable only when the cylinders did not exceed 16in. diameter, but that for 17in. and 18in. cylinders it was either too narrow or the cylinder centres had to be spaced further apart, to the detriment of the crank web thicknesses. Consequently Sharp's engines of 1846–9, with 18in. cylinders, were designed as a compromise. The cylinders were placed at 2ft. 3in. centres and inclined downwards, with the slide bars above the leading axle, but the valves were below, the port faces forming a ∧. Only the valve spindle drag link passed underneath the leading axle, but as it was jointed by pins at each end, it was easily disconnected when the engine had to be lifted. In 1852 Matthew Kirtley designed twenty goods engines for the Midland Railway with 17in. by 24in. cylinders, which were built by Stephenson and Kitson; in these a similar valve gear—as shown in Fig. 106—was used. The back end of the drag link was suspended from a bent swinging lever to a projection on which the die block was attached. The expansion link was suspended from a trunnion in the middle and on the outside only of the link. McConnell also used this motion in his 18in. goods engines.

In 1853 Kirtley reduced the size of cylinders in twenty goods engines, generally similar to those of 1852, to 16½in., placed the valves between and adopted the Stephenson direct motion now usual. The cylinders were spaced 2ft. 6in. between centres, the crank webs were 4½in. thick, and the connecting-rod bearings 4½in. long. The inside axle journals were 6½in. diameter by 4in. long, and those in the outside frame 6in. diameter by 8in. long.

But Messrs. Stephenson themselves did not always use their patented steam chest between the cylinders, more especially for passenger engines, as is shown by the examples with outside steam chests and excentrics which have been described.

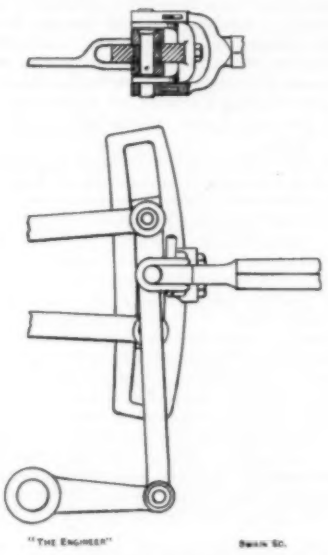


FIG. 107—HAWTHORN'S LINK MOTION, 1851

The 2–2–2 express engine, by Hawthorn, at the 1851 Exhibition, had the modified link motion shown in Fig. 107. In it the expansion link was of extra length, and instead of being pinned to the ends of the excentric rods and having to be raised and lowered with them, was directly connected by an eye joint to the valve rod, from which it was suspended, so that its weight was removed from the reversing gear. The excentric rods were forked and pinned, one to each end of a long slide block movable in the expansion link, the movement being derived from a weigh bar shaft below.

It was claimed that this gear was easier to operate, since less weight had to be lifted when reversing, also that the long slide block increased the durability of the link, and that less head room was needed under the boiler. Nevertheless the use of the gear was never extended, and the similar engines built by Hawthorn in 1852 for the Great Northern Railway had the ordinary Stephenson link motion.

The necessity for expansion brackets for supporting the fire-box casing on the frames, at the same time permitting the boiler to expand when hot, had now become evident. Sharp, Stewart and Co. designed a very complicated arrangement for their 0–6–0 goods engines with double frames, in which two sliding surfaces were provided. A heavy bracket attached to the casing embraced the outside frame upon which it could move, and at the same time the bottom of the foundation ring, which had a convex surface, rested upon a hollowed out angle iron riveted to the inside frame.

The plate springs of Stephenson's, Wilson's, Kirtley's, and other engines were usually 3ft. long, and in some 0–6–0 long boiler engines were set at an angle to clear the fire-box casing. In Sharp's engines, until 1850, the spring length was only 2ft. 6in., and in their long boiler engines, rather than set the trailing springs at an angle, their length was reduced to 1ft. 10in. only.

In some of Sharp's inside-framed engines, in which the trailing axle lay behind the fire-box, in preference to taking up room on the footplate with long plate springs, a double spiral spring was used, consisting of external and internal coils of ⅞in. and ¾in. square section steel respectively. The springs were enclosed within a sheet iron casing as a protection for the men in case of breakage.

Combined india-rubber hydro-pneumatic bearing springs were tried on a railway in South Wales. They consisted of a vertical india-rubber cylinder with thick walls and enclosed within a casing. The hollow interior was partially filled with water. As the spring pillar moved upwards the sides of the rubber cylinder bulged inwards, forcing up the water into an enclosed air space above. The compression of the air added an elastic cushion to the spring.

Frames have already been considered in detail. The following comparative costs of repairs, covering a period of ten years' work, 1866–1875, on the Great Southern and Western Railway, Ireland, of 2–2–2 engines, eleven by Sharp with double frames, and twenty by Bury, Curtis, and Kennedy with inside bar frames, were given by A. McDonnell.[2] Both types of engine were designed by the makers in 1846–7, and were therefore 20–30 years old. Sharp's engines had 15in. by 20in. cylinders and 5ft. 8in. driving wheels. The boiler pressure was not stated, but would be 80–100 lb. The permanent way during the period covered was in bad condition.

	Eleven Sharp engines. Pence per mile.	Twenty Bury engines. Pence per mile.
Average life per engine, miles	465,471	388,028
Running gear repairs—		
Axles	.007	0.0
Tires	.032	.097
Springs	.036	.028
Sundries for wheels and frames	.008	.012
Axle-boxes	.007	.054
Axle brasses	.013	.007
Total, materials only	.103	.198
Boiler repairs—		
Copper plates	.024	.002
Copper stays	.007	.001
Tubes	.032	.009
Fire-bars and brick arch	.023	.047
Sundries for boiler	.014	.006
Total, materials only	.100	.065
Total cost of repairs for whole engine, materials and wages	1.11	1.13

Bury's boilers referred to above had the D-shaped fire-boxes. Those of Sharp's engines were of the usual type, and had circumferential butt joints with cover strips outside. During this period most other makers constructed their boilers in three rings, of which the middle ring was the largest, but many of these boilers had the defect of two longitudinal lap joints in each ring. Sharp Brothers made their rings with a single longitudinal butt joint with one internal cover strip.

The usual practice was to stay the ends with gussets or stay rods, one end of which was secured to the barrel. Amongst those who discontinued this practice and adopted longitudinal stays between the smoke-box tube plate and fire-box casing were J. V. Gooch on the Eastern Counties Railway, and Robert Sinclair on the Caledonian Railway, though the writer does not know whether they were the first to make this improvement.

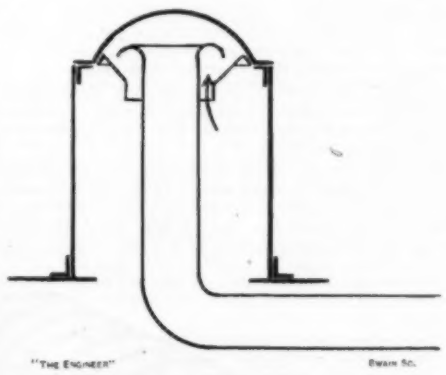


FIG. 108—R. AND W. HAWTHORN'S STEAM DOME

Messrs. Hawthorn, though they built many engines with domeless boilers and perforated steam collecting pipes, also constructed a large number with domes, in which the open end of the steam pipe was protected by a baffle chamber, as shown in Fig. 108. The regulator was placed in the smoke-box.

A variable blast pipe reappeared in Sharp's heavy goods engines of 1848–9. It was similar in principle to that of Rothwell in 1832, and took the form of a hollow internal cone, which could be raised or lowered in the blast orifice by means of a system of levers and rods worked from the footplate. Messrs. Hawthorn also applied a variable blast pipe to some engines built in 1846 for the North British Railway.

Smoke-box doors of the double folding type began to give place to single doors. The former were diffi-

[2] Inst. Civil Engineers, 1876.

cult to keep tight, though they were retained on the Midland Railway until 1873, and on the Great Southern and Western Railway (Ireland) until a much later period. The circular dished doors appear on Stephenson's drawings of the long boiler engines of 1843,[3] and were probably invented by this firm, but they did not come into more extended use until 1847, when they also appeared on Wilson's and Hawthorn's engines. The doors were secured by cross-bar and handle. Several locomotive superintendents preferred the Gooch door of ⊃ form, which opened upwards about a horizontal hinge. These doors, which had an awkward knack of falling unexpectedly, when open, were used on the London and North-Western Railway until 1883, with the addition of a bridle and central bolt.

The grates of the later engines of Bury, Curtis and Kennedy were in two portions. The bars of the shorter back portion were provided with hooks which rested upon rounded projections attached to a cross bearer in such a way that by withdrawing a bolt worked by a lever from the footplate, this portion of the grate rotated about the bearer, and the fire could be dropped quickly.

Gauge glasses with automatic ball valves appear to have been first used between 1851 and 1855, but the original suggestion is stated to have been due to the eminent German Professor Reuleaux, whose idea

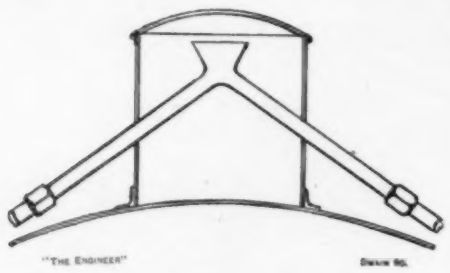


FIG. 109—SANDBOX, D. GOOCH 1849

was carried out by Schebesta on the Austrian Kaiser Ferdinand's Nordbahn.

Steam pressures, which in 1845–9 were 100 lb. per square inch, had risen to 120 lb. in 1852, though, as mentioned previously, both McConnell and Sturrock used 150 lb. in many of their engines from 1851 onwards.

About 1851 Sturrock and Hawthorn introduced the practice of shrinking hoops over the webs of crank axles, and in 1853 David Joy, then locomotive superintendent of the Oxford, Worcester and Wolverhampton Railway, passed a bolt through each crank pin as a safeguard in case the crank axle broke. The latter improvement subsequently remained in abeyance many years, until S. W. Johnson re-introduced it on the Midland Railway.

The Ramsbottom dished piston with narrow spring rings made its appearance during this period, about 1852.[4] For some years they were used on the North-Eastern Division of the London and North-Western Railway, of which Ramsbottom had charge of the locomotive department at Longsight, Manchester. Three narrow steel or iron rings, ¼in. wide, were used at first. In later years two broader rings of cast iron became standard practice.

The long forked connecting-rod was frequently used by Stephenson until about 1855 on both inside and outside cylinder engines, and rods with short forks, as introduced by Alex. Allan, were the practice on the Crewe-built engines of the London and North-Western, and on several of the Scotch railways. Connecting-rod ends with gibs and cotters and dovetailed straps were general. Both Stephenson and Sharp added bolts to secure the strap, and from this practice there was evolved the present standard big-end for engines with inside cylinders, on the appearance of which the dovetailed straps with their sharp corners, always a source of weakness, began to disappear, except on the London and North-Western Railway. The writer cannot say who originated the modern big-end with cotter and two bolts, but it was applied to Matthew Kirtley's Midland goods engines of 1852, which were built by Stephenson and Kitson.

The Caledonian Railway tank engines of 1853–4, by R. Sinclair, with intermediate driving shaft, mentioned previously, had outside Gooch valve gear, arranged similarly to the system so frequently adopted on the Continent. There have been very few cases of outside excentric valve gears in this country, where they originated, and these were confined to Crampton's and a limited number of early Caledonian engines, with one example by J. Beattie on the L. and S.W.R. The sides of the tanks of the Caledonian engines were formed by the main frames between the smoke-box and fire-box, a method adopted about fifteen years later by Krauss and Co., of Munich. The ends of the tanks formed transverse frame stays.

Most sand-boxes were of a primitive form. In D. Gooch's saddle tank passenger engines of 1849 the sand-box was placed on the top of the saddle tank and arranged as in Fig. 109, with a funnel near the top, out of which two branch pipes descended to the front of the driving wheels. There was no method of working it from the footplate, and the fireman had to get on to the top of the tank to ladle sand down the funnel. In some later tank engines of 1852 the single sand-box was transferred to the front of the smoke-box, where the fireman could get at it more easily from the front buffer plank. Subsequently, a sand-box was placed on each side of the engine platform, in front of the leading wheels. But in Sharp's goods engines of 1848 we fine a modern sand-box on each side under the platform, in front of the driving wheels, with an outlet valve worked by a rod from the footplate.

In regard to tenders, several designs have been shown in preceding illustrations, and the four-wheeled tender with inside bearings—Fig. 48 *ante*—by the Vulcan Foundry may be noted. The same firm in 1845 constructed a tender for a German railway, in which the water was contained in a cylindrical "boiler" tank.

Here a word of caution is perhaps necessary. The student of the history of locomotive details sooner or later discovers that "there is nothing new under the sun." Without putting too literal a meaning upon this, it is undoubtedly the case in many instances that improvements ascribed to particular engineers are found to have been tried by others at an earlier date. As an example of this, wind deflectors on the front of the chimney top may be instanced. These are frequently supposed to have been of French origin, but some of George England's engines of 1851 were fitted with them. Unfortunately, England applied them to tank engines, on which, when running bunker first, the deflectors were worse than useless, owing to the down draught produced, and were consequently discarded. Many French tender engines were subsequently supplied with them, but they did not reappear in this country until F. W. Webb revived them at the end of last century.

[3] Illustrations in Warren, pages 352 and 354.

[4] This date was given by W. P. Marshall, "Proc.," Inst. C.E., Vol. 133.

Wood Stave Pipe.

The use of wood for water pipe is of great antiquity, hollowed trunks of trees appearing to have figured in very ancient times. In quite a number of American cities wooden water mains of more recent date are frequently unearthed, and incidentally it is in America that extensive use is made of the more modern wood stave pipe. In the city of Boston bored wood pipes would appear to have been laid in 1650 and to have remained in use for 200 years, and several lengths were installed in New York as far back as 1793. It is also on record that in London a water company used bored logs in 1619, and these pipes appear to have done service for some 200 years. Of course, all these pipes being merely bored logs, were strictly limited in diameter, but the fact that they were constantly saturated affected their preservation for very long periods. For the most part their strength depended upon the thickness of the shell, and it is only comparatively recently that metal reinforcement has been introduced, followed by the modern wire reinforcement for small pipes and the adjustable screwed bands for larger ones. Regarded for some fifty years rather in the nature of a makeshift in localities where timber was plentiful and cheap and metal pipes costly or unobtainable, it is now fabricated to a considerable extent mainly in connection with water power schemes.

Wood stave pipe certainly possesses several advantages when suitable timber can be obtained locally. The sections in the form of planks or staves are comparatively light and the equipment for cutting and grooving is of the simplest and, moreover, is readily erected in any suitable situation. The pipe itself is relatively simple to construct. Suitably designed and constructed, it is sufficiently strong for quite heavy pressure work, curves, both vertical and horizontal, are easily effected, and, above all, it is non-corrodible. Apart, therefore, from any local considerations which would be against its use, it is a very attractive means of pipe building in suitable localities. Moreover, it is usually cheap, often considerably cheaper than iron or steel, and it compares very favourably in this respect with concrete.

General Considerations.

The staves of wood are milled with their outer and inner surfaces conforming to the cylindrical bore and surface of the pipe. The butting edges are radial. Along one radial edge a triangular tongue is cut, which fits into a corresponding triangular groove along the other edge. This prevents any internal projection and also prevents leakage. The staves are usually cut in random lengths with square ends. The joints between the stave ends are made by means of small steel tongues fitted into grooves, frequently cut on site. The staves are held together by steel bands, which will be discussed presently, their diameter and spacing being dictated by the diameter and internal pressure of the pipe. One of the essentials to durability of a stave pipe is that it shall always be full of water under at least some pressure. Any drying out is bound to cause leaks and frequent dryings will result in rot. For this reason wood stave pipe is unsuited to situations within 30ft. of the hydraulic gradient.

Material.

So far as American practice is concerned the material employed in the manufacture of the pipes is confined to two timbers—California redwood and Oregon or B.C. Douglas fir—the latter being mainly used in Canada on account of the high cost of the former. It proves excellent for the purpose, having considerable strength and being obtainable in long straight lengths. It is desirable to avoid sap wood, but provided it does not extend more than ¼in. deep on the inner face, little or no harm will result from it.

Sap wood is of less significance when the timbers are creosoted, which is now becoming a prevalent practice. The thickness of the staves is determined by considerations of strength. That is, there must be sufficient thickness of shell to resist any tendency to go out of the round under pressure and to bridge between cradles without sagging. On the other hand, the thickness must not exceed the limit of saturation under pressure. The width of stave used is of small importance and is determined by the size of the timber locally available. Nothing is gained by using abnormally wide staves to reduce the number of longitudinal joints. The tongues referred to above serve to seal the butt joints between staves. The tongue slots can be cut at the factory. They must ensure a tight fit on the tongues and are generally $^1/_{32}$in. to $^1/_{16}$in. less in depth than half the width of the tongues. The latter, generally of flat galvanised steel, are $^1/_{16}$in. to ⅛in. greater in width than the stave, so that they bite into the wood all round. Despite some fancy designs of tongue, the plain flat article of galvanised steel generally proves the best and is, moreover, simple and cheap.

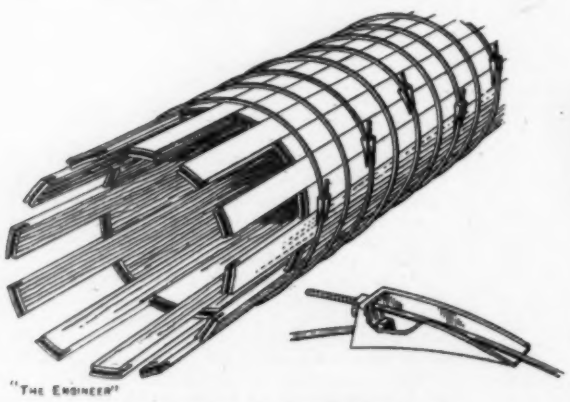


FIG. 1—CONSTRUCTION OF WOOD STAVE PIPE

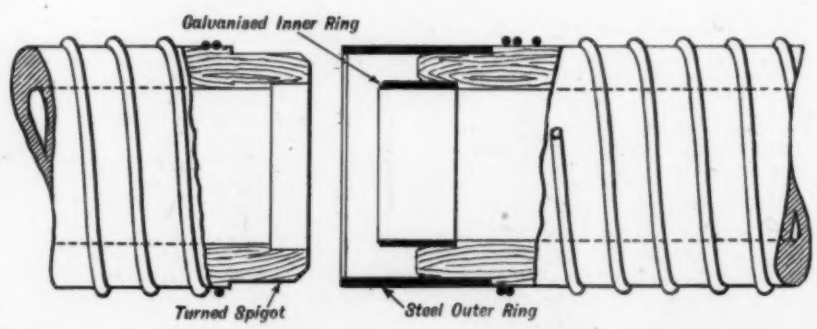


FIG. 2—SPIGOT JOINT FOR WIRE-WOUND STAVE PIPE

CONSTRUCTION.

The general method of construction of a modern wood stave pipe is shown in Fig. 1. Each band is tightened and held in place by the coupling shoe shown in detail. The whole stress, it will be observed, comes on the bands. The workable thickness of the timber used, will always exceed that which would be necessary to withstand the pressure between any two bands. It is therefore necessary not only to calculate the size of the bands, but also their distance apart. The minimum diameter may be put at ⅜in., otherwise there is risk of the bands cutting into the wood.

An empirical formula for diameter reads—

$$d = \frac{D + 2t}{80}$$

and the distance apart may be calculated by the formula

$$s = \frac{65\,(D + 2t)^2}{16\,(p\,D + 200\,t)},$$

where

d is diameter of band in inches,
D is diameter of pipe in inches,
t is thickness of pipe in inches,
p is water pressure in pounds per square inch,
s is centre to centre distance of bands in inches.

The smaller s the greater the internal bursting pressure of the pipe; but, generally speaking, above 300 lb. working pressure is not advised for wood stave pipe; not so much on account of lack of strength, but because the cost becomes excessive and iron or steel becomes the more economical. The finished thickness of the staves varies from about 1¼in. for 30in. pipes to 3in. for 10ft. pipes.

Bands.—The bands employed are usually round steel rods of a tensile strength of 60,000 lb. per square inch. They are made with a button head on one end and a thread, usually rolled, on the other. Rolling the thread maintains the threaded portion nearly as strong as the remainder. Each band is supplied with nut and washer. They are connected, as shown in Fig. 1, by a malleable cast iron shoe, which is provided with a seat or grip that engages the headed end of the band, and a bearing surface against which the nut is tightened. The metal work is coated with anti-corrosive solution. It should be borne in mind that the formulas previously given are strictly empirical. The final choice of size and spacing is usually only settled after a detailed investigation of the stresses involved. The actual stress considerably exceeds that imposed by the head of water in the pipe. There is, for instance, the initial stress imposed by tightening up the pipe during construction, which is further increased by the expansion of the wood due to saturation. Then again there are certain modifying factors, such as the compressibility of the wood, all of which have to be duly considered.

Supports.—Pipes up to 48in. diameter laid on the surface may be cheaply supported by saddles consisting of a sill with chocks sawn to fit the circumference and spiked to the sill at each side of the pipe. For larger pipes, however, cradles, embracing the pipe for about one-third of its circumference, are used. They are of a simple nature, which need no comment. Pipes over about 8ft. diameter may call for trussed rod cradles supporting half the circumference of the pipe. Here the design calls for more care, the stress in the truss rods requiring to be accurately determined and the bearing plates which support them properly designed.

Wire Bound Pipes.—For diameters up to 24in. wood stave pipe is often factory-made in lengths. It may be obtained in varying lengths up to 20ft. and in diameters as small as 2in. The head which may be used depends upon the gauge of the wire and may be as much as 500ft. The wire is made of high-grade open-hearth steel, galvanised. It is wound on the pipe under tension, which compresses the staves. The tension and compression are maintained by stapling the wire at one end of the pipe and by passing two or more turns of wire over the stapled end. At the finishing end two or three turns of wire under tension are passed through the prongs of a steel clip, these prongs being hammered down over the wire, firmly clinching it in place. With the wire binding complete, each section of pipe has a tenon machine-cut in each end or a tenon on one end and a recess in the other, according to the class of joint used. The pipe is finally dipped in hot tar and asphalt and rolled in sawdust.

Joints.—The inserted joint as effected by the tenon and recess as described, is simple enough and requires no further description beyond stating that both are machined to ensure a tight drive fit, which is further increased by the swelling of the pipe. It is suited to small low-pressure pipes. For more severe conditions there is the sleeve coupling. These pipes have two tenon ends, each driven into the couplings. Up to 14in. these couplings are wire bound and not adjustable, tightness depending upon the drive and subsequent swelling. Another class of coupling suited to heavy duty consists virtually of a short length of wood stave pipe of the built-up class, the tightening of the coupling being effected by the nuts on the bands.

Steel Couplings.—While inserted and collar joints on factory-made stave pipe prove to a limited extent quite satisfactory, they have many shortcomings, amongst which may be mentioned liability to damage in transit, shrinkage and subsequent rot. Steel couplings undoubtedly make a better job. The arrangement is shown in Fig. 2. It will be seen that the pipe end has a turned spigot and socket which accommodate the metal coupling rings. These rings have an electrically welded joint and are galvanised, and as no wood is exposed when the joint is made there is no liability to drying, shrinkage or rot.

Durability.—The decision to install wood stave pipe in preference to iron, steel, or concrete is largely a matter which must be decided by local considerations. If, however, local conditions are well suited and the cost is favourable, the finished product, properly constructed and maintained, may be regarded as a sound engineering proposition. The internal surface of the pipe does not rot or abrade and any thin deposit of slime adds to rather than detracts from the carrying power by lessening resistance. Creosoting is to be generally recommended, and if that is not done to the whole timbers it should be done to the stave ends. Total burying where desirable in sand or clean gravel protects the pipe, but partial burying must be rigorously guarded against, as it will amost certainly induce rot. The metal work must be coated in the first instance with proper composition which should be touched up as where and when it disintegrates. The shoes should be made of malleable castings, which last longer than steel. Vigilance is, however, necessary on the completed line. The pipe must be kept clear of earth and, as stated, the metal work kept coated. Spraying by the air method with creosote oil is to be recommended, as it is cheap and effective.

Institution of Naval Architects.

No. II.*

THE second paper taken on the opening day—April 3rd—of the Annual Meetings of the Institution of Naval Architects was that by Professor F. P. Purvis, entitled "Japan's Contribution to Naval Architecture." It was presented by the author in person, and it revived many memories. The following is a precis of it:—

JAPAN'S CONTRIBUTION TO NAVAL ARCHITECTURE.

After reviewing various papers in the "Transactions" contributed by Japanese members, and commenting on the work of the Japanese Society of Naval Architects, the author refers to Japan's indebtedness to outside help in the furthering of her naval progress. In this connection mention is made of the work of the late Emile Bertin and of English constructors, including Sir Edward Reed, Dr. Elgar, Sir William White, Sir Philip Watts and Sir Alfred Yarrow. Some particulars are given of the experimental tank constructed by the Japanese Navy Department at Tsukiji, Tokyo, and also the tank of the Mitsubishi Shipbuilding Company at Nagasaki, which is under the charge of Dr. Motora. The influence of Japan on the development of the modern type of warship is discussed and some particulars are given regarding Japanese experimental work in the gyroscopic stabilisation of ships, and the development of the water-tube boiler, the steam turbine, and the marine oil engine. Facilities for education and technical training in Japan are outlined by the author, who, for nineteen years, was attached to the staff of Tokyo Imperial University. The future labour conditions in Japan are described as difficult. Wages are inordinately high, with a high cost of living. With the low exchange, the wages problem is perhaps lessened, but this gain is more than set off by the export price of steel and wood. A rather disturbing labour element is a sort of principle that once a workman has been employed, he must receive compensation if discharged.

Sir Philip Watts said that Japanese Admiralty representatives came to England at the time the Esmeralda was built for the British Navy many years ago, and as a result two cruisers of the same type were ordered for the Japanese Navy. Those vessels, the Naniwa and the Takachiho, each of 3700 tons displacement and mounting as main armament two 10in. and six 6in. breech-loading guns, were built by Armstrongs, who constructed other vessels for the Japanese Navy, the most important being the battleships Hatsha, of 14,967 tons displacement, and the Kashima, of 16,400 tons. Those who were then responsible for Japanese policy desired special attention to be given to armament in relation to size and speed, and it was found possible in armoured cruisers of the "Asama" class, which were of less than 10,000 tons displacement, to fit 8in. guns twin mounted at each end. The armament of British cruisers of the "Powerful" and "Drake" classes, of 14,000 tons displacement, was a single 9in. gun at each end of the ship. The policy of sending Japanese students to the naval colleges in England had borne good results, a typical example being the excellent work of Constructor Vice-Admiral Kondo.

Mr. W. J. Berry bore testimony to the unremitting industry of Japanese students at the Royal Naval College and to their careful training in Japan, for which, to a very large extent, Professor Purvis had been responsible.

Captain Toyoda said that as an officer of the Imperial Japanese Navy he had experience of the long and valuable association of Professor Purvis with naval construction in Japan. As one familiar with the handling of the creations of naval architects he could bear testimony to the fact that many naval battles were won in the drawing-office. Professor Purvis had referred to the indebtedness of Japan to other nations in the development of a school of naval architecture. Japan would never forget that debt, and he desired to put on record how much his country owed to Great Britain for the development of the Japanese Navy and mercantile marine. From the very beginnings of the Japanese Navy help was rendered by the British Admiralty and by private firms in Great Britain. If Japan had failed to do much original work it was because attention had had to be concentrated on the task of overcoming the disadvantage arising from the lack of shipbuilding facilities in the country.

Sir Archibald Denny referred to his association with Japanese students during his own years at college, which had resulted in lifelong friendships. His firm had built a number of vessels for Japan, including the Nagasaki and Shanghai for the Nippon Yusen Kaisha, and had assisted in the establishment in Japan of an experimental tank.

Dr. Percy Hillhouse, speaking from knowledge gained in the teaching of naval architecture at Tokio University, commented on the progress which had been made. A feature of the system in Japan was that after training the student had a right to work. While shipbuilding was active no difficulty was found in putting students into the shipyards. When the slump came in the industry those working in the shipbuilding establishments claimed the right to be financially compensated for lack of employment and the claim was conceded.

Sir John Biles expressed doubts whether construction costs in Japanese yards were lower than those of Great Britain. Labour in Japan was cheap, but, as Dr. Hillhouse had stated, when there was no work the men had to be maintained. Their livelihood was a charge on the shipbuilder.

A long discussion took place on the paper by Mr. G. H. Hoffmann, "Analysis of Professor Sir John H. Biles' paper on H.M.S. Wolf Experiments," of which the following is a summary:—

EXPERIMENTS ON H.M.S. WOLF.

The experiments made in 1905 by the Committee on Destroyers on H.M.S destroyer Wolf showed that the ship was not nearly so stiff and strong as was to have been anticipated from theoretical considerations. As a measure of the discrepancy the value of the modulus of elasticity of the ship, as a whole, was calculated from the known bending moments and deflections on the assumption that the whole sectional area of the longitudinal members of the ship were fully effective in contributing towards the moment of inertia I of the cross-section. The value of E thus arrived at—about 10,000 tons per square inch—was compared with the ordinary value of E—about 14,000 tons—as determined from a strip of solid plate in a testing machine.

Marineschiffbaumeister Pietzker, of the German Navy, argued that the discrepancy should be accounted for not by supposing E to suffer a reduction but by supposing a reduction in I, that is to say, by supposing that part of the ship's section only was fully effective. To calculate the effective I he neglected as fully ineffective the plating attached to longitudinal stiffening members, except to the extent of 20 to 25 plate thicknesses on each side of the stiffening member. He argued, apparently without giving a satisfactory explanation, that the rule should be applied not only to the compression side of the ship girder but to the tension side as well.

Applying Pietzkef's theory to the Wolf's section the author found that for the ship standing dry in the sagging condition, the moment of the internal stresses amounted to 1100 foot-tons, as compared with a recorded bending moment of 3120 foot-tons, indicating a deficiency in Pietzker's moment of 2020 foot-tons.

As a first correction the author decided to add to Pietzker's moment, that due to to those parts of the ship's plating which, although outside Pietzker's "flanges," could be considered as fully effective in that they were not stressed above the buckling point. The additional moment thus contributed amounted to 564 foot-tons, so that the deficiency still amounted to 1456 foot-tons.

The author further added to the Pietzker moment by assuming that the plating on the compression side of the ship girder, even if buckled, would contribute to the moment of the internal stresses. The buckled plates, it was argued, would contribute, so long as the strain in them was elastic, a force equal to that which caused the buckling to begin, that is to say, the buckled portions were considered as columns with fixed ends stressed above the buckling point, in which case, as the ordinary column theory shows, the column resists with a constant force, equal to the buckling load, for all strains. There was thus added to the moment of the internal stresses a moment of 1326 foot-tons, giving a total of 2990 foot-tons, as compared with a recorded bending moment of 3120 foot-tons, indicating a deficiency of about 4 per cent.

A similar treatment of the subject for the ship in the sagging condition, and with the hull immersed in water to varying depths above the keel, showed similar substantial agreement between the calculated and the recorded moments. It was not found possible to investigate the subject with the ship in the hogging condition.

Mr. J. Foster King admitted that when the paper on the Wolf experiments was published he had not treated it with the respect it deserved. New considerations had arisen during the past few years in the design of merchant ships which had made it unnecessary to pay too much attention to some of the old theories. It was now realised that compressive stresses were as important, and perhaps more important, than the tension stresses which merchant ship designers had been in the habit of using as a basis for scantlings, and it became necessary to look for a standard for thin plating. The system which he had adopted, based on Euler's formula, had stood the test of ten years' application to merchant ship work, and the correctness of the assumptions made was confirmed by the mathematical reasoning of Mr. Hoffmann's paper.

Sir John Biles did not regard the paper as a detailed criticism of the work done on the Wolf, but rather as an attempt to carry the investigation made on that vessel another step along the academic path. The main object of the experiments on the Wolf was to determine certain points in connection with the strength of torpedo-boat destroyers. The bending moment in ships of that class was a factor of great importance. The Committee reached the conclusion that the stresses put upon destroyers in dock and successfully resisted were greater than the stresses experienced at sea. Mr. Hoffmann's investigation indicated that in some parts of the ship's structure the stresses were greater than had been assumed on

* No. I. appeared April 3rd.

the theory of uniform distribution of stress over areas equidistant from the neutral axis. To that extent a new line of research had been opened up.

Professor T. B. Abell said that Mr. Hoffmann had endeavoured to explain the theory of the modulus of elasticity in the light of experiments on a large structure and had suggested an explanation which might be partly true. In a modern ship stresses due to longitudinal bending did not reach the buckling stress, but in the Wolf they exceeded that stress for thin plates. It was a very difficult matter to try and assess the stresses in a ship's structure as a whole. Although the experiments on the Wolf admirably fulfilled the purpose for which they were made, they should not be used to serve other objects. It would be very useful if the pressure on the bottom plating of a ship at sea could be measured, but it could not be derived from the Wolf experiments.

Dr. A. M. Robb said that a point made by Mr. Hoffmann as to the discrepancy between the modulus of elasticity measured by the deflection of a structure as a whole and the modulus as measured by tension experiments in a plate had disturbed the minds of naval architects for a long time. One explanation which had been given was the slipping of rivets, but that was not confirmed by the experiments carried out on riveted joints, and it was, moreover, an explanation which was at variance with fundamental assumptions. The explanation given by Mr. Hoffmann was more rational. If it were possible to include in calculations the effect of the shear stress component some progress would have been made towards explaining the discrepancy to which he had referred. It was because Mr. Hoffmann excluded the effect of shear stress that he had some doubt as to the validity of his reasoning.

Mr. Lloyd Woollard thought the paper might be misleading if it was held to imply that the strength of the Wolf or of other British destroyers had been in question. That was not the case. It was the fact, however, that in a complex structure, like a ship, minor discrepancies between theory and practice were certain to exist. He suggested that Mr. Hoffmann should apply his theory to girders and bridges as well as discussing the more difficult case of a ship. It was of interest to note that according to the theory advanced even the parts in tension did not resist evenly, water pressure apparently relieving portions of the material lying between the stiffeners of part of their stress and at the same time setting up higher pressures on the stiffened portions. More confirmation of the remarkable results set out in the paper was required.

Much interest was aroused by the presence at the meeting of Admiral D. W. Taylor, whose paper on "Wake Propeller Coefficients" evoked a protracted discussion. An abstract of it follows:—

WAKE PROPELLER COEFFICIENTS.

For the majority of vessels, fairly reliable information is available concerning the power and revolutions for a single speed at a known displacement and trim. The object of the paper is to present an analysis of such data resulting in the deduction of a coefficient of propeller performance, which may be used to design the propellers of new ships resembling in size, fullness, propeller type and propeller positions the existing vessel or vessels providing the available data. The coefficient in question, designated the "wake propeller coefficient," is a function of the horse-power P delivered to the propeller, of the speed V of the ship in knots, of the propeller diameter d in feet, of the nominal pitch p in feet, of the revolutions per minute R, and of a "power absorption coefficient" S. It is expressed by the equation:—

$$W = \frac{1000\ P\ V}{S\ d^3\ p^3 \left(\frac{R}{100}\right)^4}$$

It is shown that the wake propeller coefficient for each of fourteen different vessels subjected to accurate speed trials, was reasonably constant at all speeds, although the value of the coefficient differed from vessel to vessel according to fullness of form, &c. When designing a new propeller, estimates of P, V and R are normally available, W can be estimated from the wake propeller coefficient of an existing similar vessel, and S can be determined from a knowledge of the desirable apparent slip ratio in conjunction with a table in the paper, which connects S with that ratio. The designer is thus enabled to calculate the value of the product $d\ p$. The pitch is then determined by the usual formula connecting it with speed, revolutions and apparent slip, and with p known, d can be calculated from the above product. An alternate procedure is described whereby, without assuming a value for the apparent slip, the designer may make his final choice of the pitch and diameter in light of the effect which his choice will have upon the efficiency of the propeller.

Sir Archibald Denny said that the paper sought to provide a formula by means of which the wake of any projected design of vessel could be approximately estimated. Admiral Taylor was aware that the only reliable method of dealing with the problem was by complete experimental tank investigation of each case, but that being a counsel of perfection he put forward a more or less reliable substitute, and the propeller designer would avail himself of his method. It must be borne in mind, however, that even in normal designs there might be wide limits of variation, and that special cases differed even more widely than those dealt with in the paper. In the case of ships fitted with internal combustion engines running at high revolutions pitch ratios were likely to be smaller, so that any error in the wake estimate would not be so serious.

Mr. W. T. Luke welcomed any new method of tackling a difficult problem, although he could not see how the suggestions made in the paper could be of much more assistance to the designer than the older methods.

Mr. H. L. Williams regarded the paper as a very practical one. Admiral Taylor proposed to use a factor which he termed the "wake propeller coefficient" to cover the wake factor, scale effect, and all the other known and unknown corrections which had to be made when applying model results to the full-sized ship. The argument in favour of this method was that experience had shown that the factor was practically constant at all speeds in a given ship and varied only slowly and fairly regularly with block coefficients for different ships. He would test this new method. In analysing trial results he had invariably found it necessary to allow for a loss of at least 20 per cent. between the engine and the screw. It seemed incredible that so large a proportion of the engine power could be wasted in the stern bearings, although the loss was greater than was generally supposed. His only criticism of Admiral Taylor's suggested method of dealing with the problem of wake was that he started his analysis from engine power instead of thrust horse-power, which was Froude's plan.

Mr. M. P. Payne, speaking for Mr. Berry, said he found special interest in the comparison, made in the paper, of wake coefficients of models with those of ships. Mr. R. E. Froude had made experiments to determine the probable ratio of ship and model wake coefficients as long since as 1882, and the conclusion reached was that the ship wake was lower by 5 per cent. than that of the model. That result was in fair agreement with the figures quoted by Admiral Taylor that the ship value averaged about 94 per cent. that of the model. That discrepancy need not, it was suggested, affect efficiency to any extent, but for a given diameter it was necessary to increase the pitch of the propeller, and that was done in Admiralty practice. The propeller dimension curves proposed for a new design were based on model results obtained at Haslar.

Mr. C. V. Telfer could not see why the wake of the ship should be less than that of the model. He noted that Admiral Taylor in his analysis had assumed a constant mechanical efficiency for the engines. He could say from some recent analyses of trials of reciprocating engines that at one-third the total load the efficiency fell to 73 per cent., while at full load it was 93 per cent. Other tests showed a variation at low and high revolutions of from 60 to 92 per cent.

Mr. A. W. Cluett expressed the opinion that the author's methods of analysing trial results to obtain the equivalent of wake factor and to obtain screw dimensions would be of use to those who did not have access to facilities for obtaining complete data. An even easier calculation might be made, involving possibly no further loss of accuracy by assuming a mean constant value for W.P. for twin and single-screw ships and a mean constant value also for S.M.

Mr. S. V. Goodall dealt with the difference in practice at the Washington and Haslar tanks. At Washington the wake results were obtained with the appendix fixed on the model, but that was not the case at Haslar. He thought the British method was to be preferred. Admiral Taylor said that a very good propeller could be designed from trial results, and he was convinced from his own experience when at Washington of the great care taken with the work carried out there that the statement of Admiral Taylor was based on far more trial results than he had quoted.

Professor J. J. Welch said he had applied Admiral Taylor's method to a case which he had already analysed by Froude's method and found that the difference between the two results was very small—about 1in. in diameter and about the same in pitch with a difference of .015 in the efficiency value.

Admiral Taylor, in his reply to the discussion, said the paper represented an attempt to make use of the law of variation found from experiments with models for propellers of different characteristics.

Mr. W. G. A. Perring presented a paper dealing with "Form Effects and Form Resistance of Ships," and this paper and the report of the Committee of the Institution on Skin Friction were the subject of a joint discussion.

FORM EFFECTS AND FORM RESISTANCE OF SHIPS.

This paper gives the results of some experiments undertaken by the author at the William Froude National Tank in order to measure the pressure upon a submerged body of mathematically calculable form. After discussing skin friction and form resistance in the light of existing experiments, the experiments upon a series of 16ft. sharp-ended symmetrical wax models derived from the mathematical form are described and the results expressed in the form of tables and curves. Some further experimental results on more normal ship forms are appended. The experiments outlined, while not sounding a final note on the subject of form effect, do show its practical importance as far as ships are concerned. The investigation made by the author would seem to indicate that the error introduced by the misallotment of a certain portion of the eddy resistance when predicting the resistance of a full-sized ship from model results is not serious. The fact emerges that some shapes lend themselves more readily to the flow of water around them than others, and two of the models tested showed unexpected results in this respect. Further experiments are in progress with plank-like bodies, which when completed should add to the present knowledge of the skin friction problem.

SKIN FRICTION COMMITTEE'S REPORT.

This report, already mentioned in the report of the Council, was framed by a committee of representatives from the principal experimental tanks in the kingdom, under the chairmanship of Sir Richard Glazebrook. All the existing data on the frictional resistance of surfaces have been surveyed. A bibliographical account of the most important papers on the subject is given in an appendix. Experiments have been carried out by W. Froude, Gebers, the National Tank, and McEntee and Taylor at Washington, with flat surfaces in water; by Zahm, Stanton, and Marshall and others with flat surfaces in air; by Beaufoy with raft-like bodies; and by Kempf with rounded surfaces in water. The maximum and minimum dimensions of the towed bodies and the speed range of the experiments are given in a table in the paper, and estimates of the frictional resistance for surfaces of 172.5ft. and 400ft. in length are worked out according to the methods and experimental data obtained by five different authorities. The difficulties of comparing resistance estimates with the actual results obtained on speed trials is referred to, and possible experiments to augment knowledge of this subject along the lines of further tank experiments with long flat surfaces, and measuring the resistance of a towed ship are considered. The Committee is unanimous in its conclusion that much more could be done to extend our knowledge of skin friction by experiments in a tank, although very considerable extension of the data would still be required in framing ship estimates. With regard to the towing of a destroyer hull, a majority of the Committee is of opinion that this should give the additional data required, and that although such tests represent a fairly serious outlay, the importance of the data to be obtained would appear to justify incurring the expense involved if the necessary funds could be raised.

Mr. G. S. Baker said he thought that the conclusion put forward by Mr. Perring of a considerable and steady variation between the two-dimensional and the three-dimensional flow round the hull was correct. The variation was fairly marked in amount, and indicated the need of readjusting old ideas that the ship form which had the least wetted surface was that which had the least frictional resistance. Dealing with the report of the Skin Friction Committee, the work of Perring and that done at Hamburg by Kempf was fairly clear evidence that knowledge of the frictional resistance of a ship was only approximate. He hoped the research would continue, and his own opinion was that it called for full scale experiments. Research was not making much headway in Great Britain at the present time, even at the Admiralty, and unless more was done there was not much doubt as to what would happen to British shipbuilding.

Mr. Summers Hunter referred to the keen competition in the shipping industry, which had forced upon all concerned the necessity of evolving the most efficient type of vessel and of propelling machinery for special trades in which at one time the shipowners of Great Britain were pre-eminent. The Skin Friction Committee's report dealt mainly with a proposal to carry out further experiments by means of towing a destroyer at various speeds, and similar experiments might, with advantage to the shipowner, be carried out with certain types of cargo boats. A greater general advance in the most efficient types and proportions of tramp steamers was overdue. During the past fifteen years his firm had engined about 750 vessels, but only ten of those ships were subjected to model tests, and four were motor ships. Yet in spite of the limited scope of the tests, he knew of cases where an improvement of from 7 to 8 per cent. was obtained by the tank experiments. He believed that in the case of vessels for which orders had recently been obtained by continental shipbuilders, the models were tested in advance. All shipbuilding firms ought to make more use of the Froude Tank, and give it financial support.

Mr. M. P. Payne regarded the results obtained by Mr. Perring in his investigation of the pressures over the surface of a body totally submerged as very interesting, especially the low-pressure indicated at the after end, where theoretically the high pressures of the bow should be repeated. The excess of total resistance over skin friction had been worked out for a number of warships, and for a battleship, battle-cruiser and light cruiser the figure obtained was from 13 to 14 per cent., and for destroyers 15 to 17 per cent. Reference had been made to the need of large-scale experiments, and in this connection the work of Mr. Frodsham Holt in 1920 showed the need for this kind of work. Mr. Holt produced evidence that the actual measured thrust for the screws of certain vessels departed considerably from either the calculated thrust or the computed resistance, unless a high thrust deduction factor, higher than model experiments would justify, was assumed. It was known, too, that the efficiency of propulsion of warships was much lower than it was from twenty to twenty-five years ago. This fact alone would make it worth while to carry out the full-scale experiments which had been suggested.

Admiral Taylor agreed that further investigation was necessary, as Froude's methods were not intended for application to large modern vessels. It would be an advantage if the Skin Friction Committee could provide fresh data which could be accepted by naval architects in all countries.

Mr. C. V. Telfer thought that Kempf's results had established the constancy of specific resistance, and if money were to be devoted to the further explorations of skin friction phenomena, tank work was preferable to experiments with a destroyer. He argeed as to the need of concentrating efforts on the discovery of the cause of the discrepancy between theoretical and actual results, so that a more efficient ship could be produced.

Mr. Perring replied briefly to some of the points raised, which will be dealt with in detail by correspondence.

A paper on "A Suggested Method of Increasing the Efficiency of the Screw Propeller," was brought up for discussion by Mr. Walter Pollock. It dealt mainly with the contra-propeller of the Star type, and we shall give an abridgment of it in a later issue.

Mr. Andrew Hamilton said that tests with the contra-propeller had been carried out about four years ago in the Clydebank tank and the increase in

efficiency shown was from 8 to 16 per cent. When the propeller was fitted in a ship of about 400ft. long and 52ft. beam, nothing like the same increase in efficiency was obtained. His opinion was that if the debit of the cost of pulling the contra through the water could be accepted, it might yield something on the credit side. More tests were required.

Mr. John Tutin said that a contra-propeller fitted behind the main propeller was not fundamentally different from the same thing fitted in front. Fitted behind, the contra-propeller could not sensibly affect the efficiency of the main propeller, but might develop a separate thrust. Fitted in front, it might or might not increase the efficiency of the main propeller, but it was obvious that it would develop a separate resistance. The mathematical analysis applied therefore only to the case of a contra-propeller behind. Perhaps Mr. Pollock would state whether the model experiment definitely indicated an improvement for both types, and, if so, approximately what was the increase of thrust obtained behind and approximately what increase of efficiency was obtained in front.

Mr. J. Hamilton Gibson said that anyone who had seen a propeller working in clear water could not have failed to observe that its action was centripetal rather than centrifugal. One of the reasons advanced for designing propellers with blades having a considerable rake aft was that the centrifugal tendency was thereby eliminated. The most effective part of a propeller was the outer area near the blade tips. Near the roots of the blades the churning action increased. This represented a waste of power. The fixed contra blades were only about half the length of those of the working propellers, and for this reason made good use of the churning action referred to. The effect would doubtless vary with the form of the ship and the design of propeller; but if an extra kick of even 2 or 3 per cent. could be obtained out of the disturbed propeller wake, it was all to the good.

Sir Archibald Denny referred to experiments with the contra-propeller carried out at Dumbarton, and said that in no case could any improvement in performance be detected. The best result was that the contra-propeller was not worse than the ordinary form.

Mr. A. W. A. Cluett said the theory of the contra-propeller was not new, and in practice it was efficient only for so long as the extra power obtained was greater than the resistance due to the presence of the blades. It was probable that the most efficient part of the contra-propeller was that near the extreme diameter of the race, and therefore the blades should extend to that part. It was stated by the author that the diameter taken was 55 per cent. of that of the propeller. To be fully efficient, the angle of the blades should vary to suit the direction of the flow of the different radial distances in the race, but it did not appear that the contra-propeller possessed that feature. The greatest effect was likely to be at high real slips, as experiments made at Haslar some ten years ago showed that there was a loss at low slips and a gain in the neighbourhood of 45 per cent. slip. The increase in efficiency was of the order of .025, representing about 5 per cent. in horse-power. It was possible that modification in the form of the guide blades might result in a greater gain in horse-power, but that always presupposed a large slip and consequently a low efficiency propeller. It would be a welcome addition to the paper if the author could include results obtained from the experiments at the Hamburg tank. They should prove instructive on this point. The slips for the Thuringia and Westfalia were in the neighbourhood of 5 per cent. The aperture of a single-screw ship was suitable to accommodate the contra-propeller, but in the case of twin-screw ships it was not so easy to obtain an effective practical arrangement.

Mr. Pollock, in reply, said a new type of contra-propeller was now being fitted, and improved results were being obtained. The tests referred to by Sir Archibald Denny were carried out with an older form, which was not so efficient.

The evening meeting on April 2nd was devoted to a fresh discussion of the second report of the Marine Oil Engine Trials Committee, which was presented and discussed at a recent joint meeting held under the auspices of the Institution of Mechanical Engineers. Admiral Sir Robert Dixon presided.

Mr. W. H. Patchell, who introduced the report, said that the tests which had been carried out had told the plain unvarnished facts, and the Committee had left others to make deductions from the facts presented.

Mr. James Brown said the report was a record of the trials of the Dolius, and the results obtained were enhanced by the fact that a model of the ship was run in the National Tank, and the values obtained were available for comparison. The records made of thrust readings taken during the trials opened up a useful field for investigation, and it was hoped that the analysis to which they would be subjected would lead to reconciliation between the performances of engine, propeller and ship. The fuel consumptions recorded in the report were satisfactory, but as the engine was the first of the type his firm had completed it was hoped that it could be improved in detail and that lower fuel consumptions would be realised.

Engineer-Commander H. B. Tostevin noted that the results from the designed full-power trial in the shops gave a consumption of .353 lb. per brake horse-power hour. Had the additional power from the steam not been available and had the whole of the power for the scavenge blower been supplied from the main engine or some other prime mover, the consumption would have been approximately .43 lb. per brake horse-power hour. The gain in economy was therefore 18 per cent., as quoted by Mr. Still at the previous meeting. He could not agree that that gain in economy was obtained at the expense of a 12 per cent. increase in weight, as the weight of the regenerators, boiler, &c., did not constitute the sole additional weight. The main engine itself was necessarily increased in weight by the fitting of a bottom cylinder cover and an increase in its overall height, and some of this additional weight must be debited to the regenerative system. He thought the mechanical efficiency recorded was somewhat too high, but was prepared to accept a figure of about 88 per cent. There was, he believed, some error in the indicator diagrams. It was not due to the pressure recording mechanism, but rather to inaccuracies in reproducing the phase motion of the piston on a reduced scale. Accuracy in that respect was very important in Diesel engine work, owing to the type of diagram. He gave some figures to show that only the most severe restrictions in the indicator connections of a higher speed engine than those of the Dolius could cause errors of the recorded pressures. Such restrictions would, however, have caused an increase in the area of the diagrams, and so lowered the mechanical efficiency. Restriction therefore in the Dolius, as might appear likely from the drawing of the fuel valve, did not give rise to any inaccuracies in the direction suggested. In the sea trials it was logical to presume that the shaft horse-power deduced from the engine data was approximately correct; that was, within a small percentage. The torsion meter horse-power could not be taken as correct in view of the propeller shaft not having been calibrated, and although an assumed value of 12,000,000 for the modulus of rigidity might be a good average, still shafts of similar material frequently showed a very wide variation when actually calibrated, figures in the neighbourhood of 11,000,000 being not uncommon. He also expressed doubt with regard to the accuracy of the zero reading, as such could only be definitely correct when the shaft was disconnected in the neighbourhood of the torsion meter, and so relieved of all torsional strain.

Mr. E. B. Moullin discussed the question of the accuracy of the torsion meter employed, and exhibited slides giving a continuous record of the torque during the whole of a revolution. An explanation of the fact that the values given by the torsion meter did not agree with the predicted values would appear to be due to miscalibration of the instruments, but tests indicated that that explanation would not serve in the present case, and it was necessary to find out from what cause the discrepancy arose.

Mr. W. J. Still said that the trials of a commercial installation, such as that in the Dolius, required a good deal of analysis before the value of the system could be fully realised. Some of the trials of the engines when working at full power clearly indicated the gains obtained when the work expended on overcoming friction and scavenge air resistance was balanced by energy produced from heat usually wasted in internal combustion engines. The fuel consumption of 0.353 per indicated horse-power during one test became 0.354 per shaft horse-power. Under favourable sea-going conditions the waste heat steam recovered on the Dolius had been proved capable of overcoming all frictional and air losses. The Dolius saved about 2 tons of oil per day over sister ships when developing over 2000 horse-power. A good deal could be done to reduce the weight of the installation while retaining the Scott-Still form, but for warship work another type of engine was required, and an experimental engine had now been constructed. It had a single cylinder of 13½in. bore by 22in. stroke, designed to develop 400 indicated horse-power at 360 revolutions per minute, and had performed satisfactorily at trials supervised by the Admiralty. A design of a proposed twin-screw installation of six-cylinder engines of the same type had been prepared, and the complete weight of the installation, including auxiliary machinery, shafting and propeller was estimated at 88 tons. Assuming that twelve cylinders would give 3000 shaft horse-power, the weight would come out at 63.5 lb. per shaft horse-power. As much as 5000 shaft horse-power could be produced at 363 revolutions per minute, and the weight per shaft horse-power would then be only 38 lb. Even that figure had been exceeded on the trial engine, which had given the equivalent of 6000 shaft horse-power at 380 revolutions per minute, which brought the weight down to 32 lb. per shaft horse-power. The mechanical efficiency of the Dolius engines on full power was not less than 90 per cent.

Mr. W. G. A. Perring said that in an engine fitted with a regenerative system, it was necessary to balance the added weight against the return of the power. In the Still engine it seemed to be profitable because it reduced the fuel consumption to about 0.35 lb. per hour, so that the Dolius, of 10,000 tons, only consumed 8.4 tons of fuel per day, which was a very remarkable performance.

Mr. G. S. Baker, referring to the doubts which had been cast upon the indicator diagrams, said that in a recent trial two sets of diagrams taken by the same people in similar weather on the same ship showed a difference of 10 per cent. If engineers could not do better than that, they should look at their own instruments before throwing stones at those of other people.

Engineer-Lieut. Hext gave some particulars of the maiden voyage of the Dolius from Cardiff to Algiers and from Algiers to Rotterdam, on which he represented the Admiralty. The consumption at 122 revolutions per minute worked out at 8 tons a day for all purposes, but at 128½ revolutions per minute it was 9 tons per day, the average for the whole trip being 8.387 tons per day for a speed of 11.45 knots. The fuel consumption per indicated horse-power was 0.338 lb. The engines were a little more powerful than were actually required for the ship.

Mr. Butler expressed disappointment that the information had not been presented in a manner to enable a bird's eye view of the results to be obtained, and asked if the data could be given in a condensed form.

Mr. Patchell, in concluding the discussion, said that the Committee had tested the Scott-Still engine impartially, and it and the builders were now beginning to know something about it. The Committee was doing all it could to discountenance the selling of engines by indicated horse-power. He desired, on behalf of the Committee, to express indebtedness to Engineer-Vice-Admiral Sir George Goodwin for his services as chairman of the Committee; and to Scott's Shipbuilding and Engineering Company, Messrs. Alfred Holt and Co., the staff of the National Physical Laboratory, and others. The Committee still required about £500 to enable it to complete the work on which it was engaged.

South African Engineering Notes.

Newcastle Iron and Steel Works.

We understand that it was definitely decided to proceed with construction work at the Newcastle Iron and Steel Works, Natal, on March 1st, and that the boilermakers, fitters and other artisans were being engaged for the purpose. It is stated to be the intention to build a third stove before the blast-furnace is actually put into operation.

The Rand Gold Industry.

Since its discovery in 1886, the Rand's proportion of the total gold output of the world has been steadily increasing, and last year it is estimated that the Rand goldfield contributed between 55 and 60 per cent. of the production of all the countries of the world. The total output of the Transvaal to date has been in the neighbourhood of £844,500,000, and of that quantity the Rand has produced approximately £804,000,000. It is estimated that approximately £628,000,000 has been distributed in European and native wages and in stores and other working costs. The following is a comparison of approximate results obtained by the Witwatersrand gold-mining industry during the years 1914 (when the war began), 1923 and 1924:—

	1914.	1923.	1924.
Tons milled	25,701,954	26,538,875	28,209,073
Gold recovered, fine ounces	8,033,570	8,898,731	9,352,396
Value of gold recovered, including premium	£34,124,434	£39,061,004	£42,112,992
Salaries and wages paid	£11,711,982	£12,389,154	£12,985,940
Expenditure on supplies	£9,532,360	£12,028,882	£13,125,472
Total working expenditure	£21,943,692	£26,553,094	£27,608,156
Total working cost, per ton	17s. 1d.	20s.	19s. 7d.
Total working profit, per ton	9s.	9s. 5d.	10s. 3d.
Dividends paid	£8,073,436	£8,411,970	£9,544,516
Direct Government revenue from these mines	£1,440,223	£2,848,024	£3,000,000 (over)

With regard to the £42,112,992, representing the value of the gold recovered, it may be pointed out that it is the amount after deducting exchange and realisation charges. With those included, the value works out at just 44½ millions.

In a letter to the *Wireless World*, Captain Eckersley, of the British Broadcasting Company, questions whether listening to distant broadcasting stations is a matter of supreme enjoyment. Atmospherics, fading and worse, he points out, tend to mar the enjoyment of a programme, and persons who listen to distant stations, he thinks, are more interested in the art of receiving the programme than in the programme itself. Broadcasting must rely for its permanency upon its artistic appeal, although there are, of course, numbers of people who are interested enough to pursue the technical side of an art. The primary consideration for a broadcast receiver, Captain Eckersley argues, is capability, not of receiving a noise over a long distance, but of giving pure reproduction at a short distance. It has long seemed to us that distance reception has been very much overrated, and we are glad to find that the chief engineer of the British Broadcasting Company supports this view. Wireless firms frequently lay great stress on the long-distance receiving properties of the sets they sell, but omit to state that in addition to picking up speech and music, they are also very liable to provide the listener with a great deal of undesirable noise.

A Large Electric Winder.

The geared electric winder which last year was supplied by the English Electric Company, of Queen's House, Kingsway, London, W.C. 2, to one of the collieries of the Dominion Coal Company, Ld., of Canada, forms a good example of recent British winding gear practice, and some account of its construction and performance may be of interest to our readers. The electric motor and the control gear were constructed by the English Electric Company, but the main gear embracing all the mechanical parts was built by Robey and Co., Ld., of Lincoln. The gear was erected at Lincoln before it was shipped, and we had the pleasure of inspecting it in Messrs. Robey's works.

The photographs reproduced on page 408 show the gear without its driving motor and with the upper gear wheel casing removed. A general arrangement of the winder is given in Fig. 1, while Figs. 2 to 4 indicate the type of drum and brake gear which is employed. The driving motor is one of the English Electric Company's standard types, specially designed for winding engine service. It has two pedestal bearings with internal slip rings, and is rated for a continuous output of 1380 brake horse-power when working at the full-load speed of 365 revolutions per minute and when supplied with three-phase, 25-cycle, 2200-volt current. The control gear consists of a contactor-operated air-break type stator reversing switch and an Allan West type liquid rotor regulator. The lever frame on the driver's platform—see page 408—is furnished with three levers, one of which operates the master controller and rotor regulator, one the working brake, and one the emergency brake. Interlocking devices are fitted so that the emergency brake cannot be re-set until the main control lever is brought into the "off" position. An electrically-driven air compressor with automatic control gear supplies compressed air for lifting the brake weights, while there is a brake solenoid for the emergency braking gear. The plant was designed for a working load of 5 tons, but the load has been about 4.1 tons since the winder was placed in commission. Under these conditions an output of 2684 tons, including the drawing of empty trains, has been obtained over a period of seven hours. Some of the details of construction may now be described.

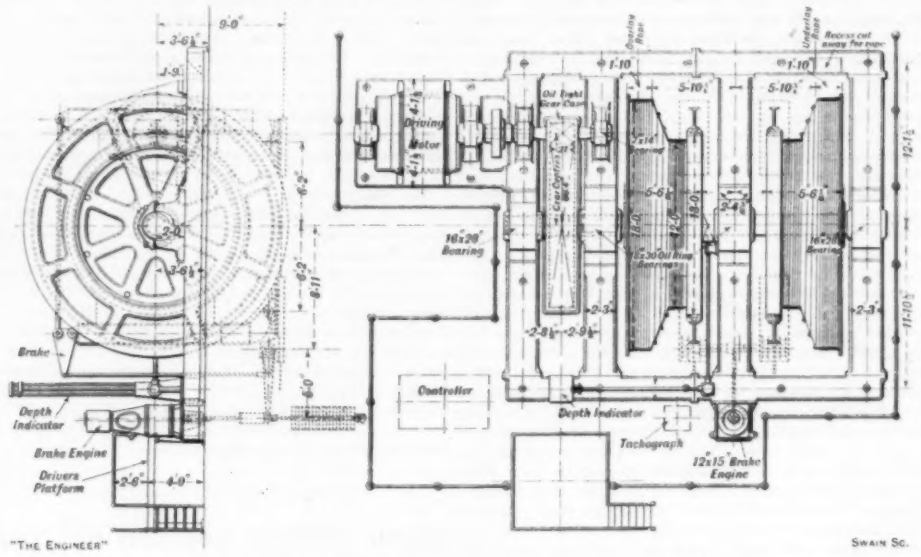


FIG. 1—ARRANGEMENT OF ELECTRICALLY-DRIVEN GEARED WINDER

Base Plate, Gearing, and Drums.

The general arrangement of the built-up cast iron base plate is shown in Fig. 1, and the views reproduced on page 408 give some idea of the appearance of the bed-plate and shaft bearings. The pedestal bearings for the pinion and drum shafts are mounted on raised machined facings and are secured in place by joggles and keys in addition to the holding-down bolts. Ring-oiled bearings are employed throughout and are fitted with removable cast iron sheets lined with anti-friction metal. The bearing covers are furnished with hinged lids to enable the oil rings to be inspected, and indicators fitted to the sides of the bearings to show the level of oil in the ring well. The motor is fixed to a base plate attached to the main framing and transmits the power through a heavy duty reversible flexible coupling. The pinion, which is forged solid with the mild steel pinion shaft, has twenty-two teeth of 1¼ diametral pitch and a tooth face width of 21in. It meshes with a double helical solid gear wheel with seventy-nine teeth. The gears and flexible coupling were made by the Power Plant Company, Ld., of West Drayton, Middlesex. A light sheet iron casing encloses the gears.

The cast iron drums, which are illustrated by Figs. 2 to 4, are of special interest, as a particularly fine example of Robey's foundry work. They are made in halves with planed joints with shrunk rings on the bosses. The drum shaft, which is of large diameter, is extended to carry the gear wheel and is bored through the centre and provided with sunk keyways for the drum keys. Some particulars of the journal bearings are given in Fig. 1. The drums are of the semi-conical type—see Fig. 2—and the inner ends are provided with a brake rim. A number of distance pieces, each consisting of a bolt passed through a stout piece of hydraulic tube, are used to brace together the inner and outer ends of the drum and to resist any end thrust from the cones. The brake rims are furnished with cast cross strips, which are turned on the top to receive a four-piece renewable brake path. The flanges on the drums are turned to receive the rope scroll, a section of which is given in Fig. 4. This part of the drum is also made in cast iron and is cast in one, with splitting plates to divide it into four parts. It is grooved for the specified number of idle and live coils of rope both on its smaller and larger diameters, and a spiral grcove which is cast on the coned part of the scroll serves to lift the rope from the small to the large radius without shock. On the inner sides of the built-up drum collars are fitted to the shaft and effectively prevent any lateral movement.

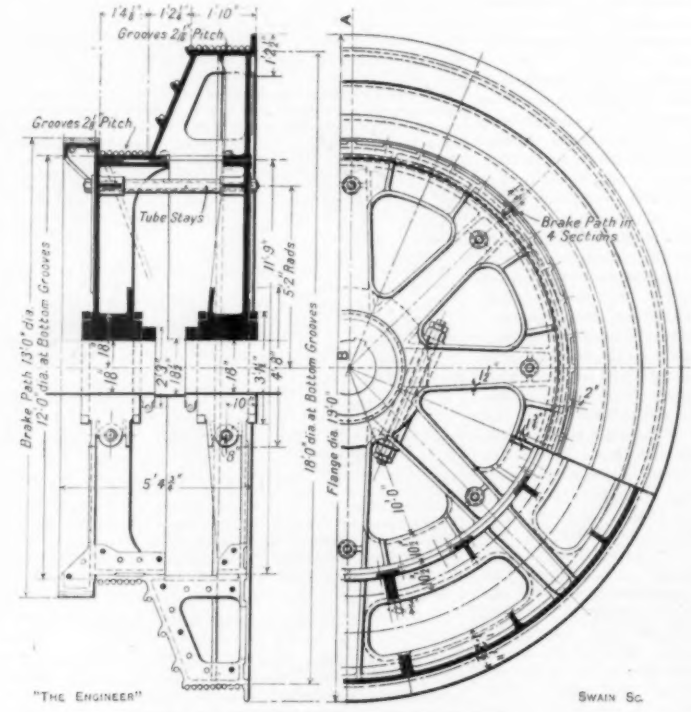


FIG. 2—ARRANGEMENT OF WINDING DRUM

FIG. 3—WINDING DRUMS AND BRAKE POSTS

The Brake Gear.

As shown by Fig. 3, two post brakes are fitted. They are made from rolled steel joists to which brackets which carry the wooden brake shoes are attached. The blocks are so designed that they can be easily renewed, and they are fitted with bonded Ferodo linings. At the bottom ends of the brake posts there are provided cast steel brackets which connect them to the sole plate in such a way that any wear on the brake blocks can be compensated. As shown in the illustration referred to above, the top ends of the brake posts are connected together with adjustable steel tension rods. Each brake is fitted with Robey's patented adjusting gear, whereby by turning a hand wheel placed within reach of the driver the finest adjustments can quickly be effected.

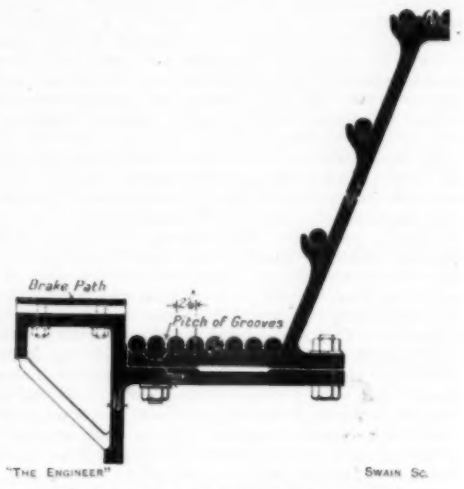


FIG. 4—SECTION OF PORTION OF DRUM

The air brake engine is of the firm's latest type, with its cylinder proportioned for a working air pressure of 50 lb. per square inch for lifting the brake weights and releasing the brake. An oil cataract cylinder is fitted—see Fig. 5—with a floating lever arrangement, and any desired braking effect can be obtained by moving the lever in the quadrant on the driver's platform. The weights fitted to the brake are sufficient to hold the maximum unbalanced load and are also designed for lowering men equal to a 7000 lb. load at a rate of 1000ft. per minute. In a case of emergency the brakes are applied automaticaly under any of the following contingencies:—(1) In the case of an overwind, (2) failure of current, (3) failure of air pressure or drop in pressure of 25 lb. per square inch, (4) by hand from the driving platform, (5) in case of overspeed by means of a centrifugal overspeed gear fitted on to the depth indicator.

Air for working the brake engine is supplied from an auxiliary electrically driven air compressor designed

for an output of from 50 to 60 cubic feet of free air per minute at a pressure of 80 lb. per square inch. The compressor is of the two-stage type with water-jacketed cylinders and patented automatic disc valves. An unloading valve is fitted on to the first stage cylinder and is connected to a 50 cubic feet capacity air receiver. When the air pressure in the storage receiver reaches 80 lb. per square inch the machine is automatically unloaded and when the pressure drops to 75 lb. per square inch the suction valve of the compressor is again opened and air is delivered to the receiver. The compressor is driven through gearing by a 15 brake horse-power motor running at a speed of 720 revolutions per minute.

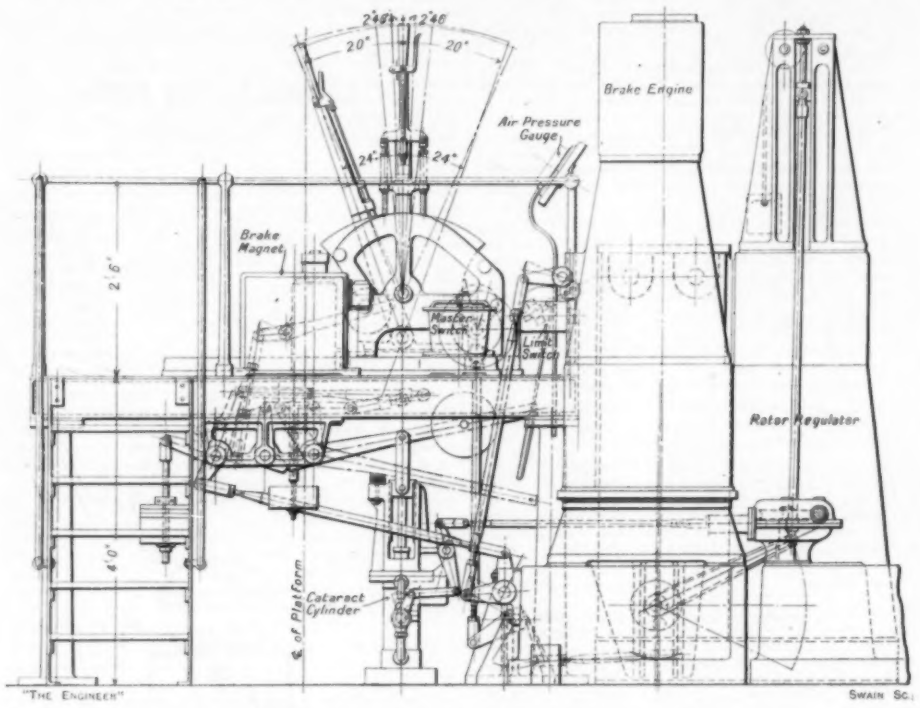


FIG. 5—ARRANGEMENT OF BRAKE ENGINE AND CONTROL GEAR

DEPTH INDICATOR AND OVERSPEED CONTROL DEVICE.

The depth indicator is shown in Fig. 6. It is of the pillar type and is mounted on the platform in full view of the driver. The two vertical screwed spindles are driven positively from the drum shaft, and on them are mounted travelling nuts provided with index fingers and triggers. The index figures show clearly the position of the cages in the shaft and the triggers are so arranged that they operate the striking gear of a gong which gives a warning when the cages reach a predetermined distance from the bank. The same travelling nuts also operate tappets, which can be so adjusted that in the event of an overwind taking place an emergency gear is put into operation. This gear cuts off the current from the winding motor and simultaneously applies the brakes without the intervention of the driver. Alongside the depth indicator is a centrifugal overspeed device which controls and retards the speed towards the end of the wind. Like the depth indicator, this device is driven directly from the drum shaft through gearing, and an elastic adjusting coupling is interposed. It allows the depth indicator and overspeed gear to be conveniently disconnected when winding rope adjustments have to be made. The vertical centrifugal overspeed governor is bevel gear driven and is housed in the base of the indicator column. The vertical motion of the governor sleeve is transmitted through a weighted lever arm and a connecting link to a toothed quadrant engaging with a bevel wheel on the overspeed gear shaft. This shaft carries an upper and a lower notched sleeve which is joined by a notched bar. The motion of the governor turns the shaft through a certain angle, the amount of which is controlled by the governor speed. The two notched sleeves are so arranged that when either one of them engages with the stop on the travelling nuts the current is cut off from the driving motor and the emergency brake gear is automatically applied. In a similar way the notched bar which connects the two sleeves takes care of the overspeed control. Springs are provided so that the overspeed gear can be re-set after it has once been tripped.

MAIN CONTROLS.

The main controls for the hoisting and braking gear, together with the driver's indicators and instruments, are mounted on a special driving platform. The platform is supported on cast iron columns and steel girders with a floor of chequer plating and steel hand rails. A little to the left—see Fig. 1—is the quadrant for the control levers. This quadrant, together with the hand control lever, the brake lever and the emergency tripping and re-setting gear, were supplied by the English Electric Company, Ld. A general arrangement of these levers and the connecting levers is shown in Fig. 5. The winding drum shaft is driven through single reduction gearing by the slip ring type induction motor already referred to. A master reversing switch—see Fig. 5—operates the main reversing switch, which is of the contactor air break type and is placed in the primary circuit of the motor. In the secondary circuit is the Allan West water-cooled liquid regulator, which is placed in the secondary circuit of the motor, and by altering the amount of resistance in that circuit varies the speed of the motor accordingly. Both the primary reversing switch and the secondary regulator are operated by one lever, which is shown at the centre of the quadrant and is directly connected to the master switch and the liquid regulator. The raising or lowering of the electrodes is, however, assisted by a compressed air cylinder and plunger. When the lever is at mid position, as shown in Fig. 5, the reversing switches are open and the liquid regulator is in the position which corresponds to the maximum resistance in secondary motor circuit. When the lever is moved through the first 2 deg. 40 min. of its travel it operates the master switch, which in turn closes the main primary switch. Further movement of the lever up to 20 deg. on either side the mid position moves the liquid regulator and cuts out more resistance the further it is from the centre. Movement of the lever towards the driver operates the motor in the forward direction, and away from the driver in the reverse direction. The brake is operated by the lever shown in the end position on the quadrant, and moving through 24 deg. either side the central position shown, the service brake is full on and the emergency brake tripped, and when moved to the other end of the quadrant the service brake is taken off and the emergency brake automatically re-set. Beneath the platform is the fast and slow braking device, which is in the form of a cataract oil cylinder with two control cocks which regulate the rate of flow of oil from one side of the piston to the other. One cock is permanently adjusted to give the correct speed of flow for slow braking, whilst the other, which is worked from the driving shaft of the depth indicator, opens towards the end of the wind and allows oil to pass quickly from one end of the cylinder to the other, thus applying the brake and retarding the cage as it nears the bank. In addition to the controls referred to there is an emergency brake which can be applied by hand or is automatically put into action by the failure of electric power supply or compressed air. It may be applied at any time, irrespective of the positions of the motor regulator lever and the service brake lever, and it can only be re-set when the motor regulator lever is in the "off" position.

The gear we have described is one of several large winding installations which have recently been completed by Robey and Co., Ld., and it is satisfactory to learn that it is giving good results in the service for which it was designed.

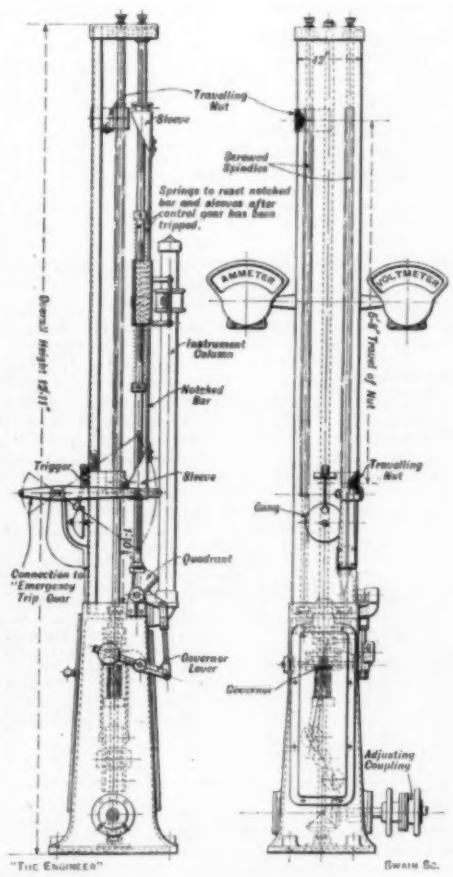


FIG. 6—DEPTH INDICATOR

The Quarter's Shipbuilding.

LLOYD'S Register Shipbuilding Returns for the quarter ended March 31st, show that the tonnage under construction in Great Britain and Ireland—1,165,468 tons—was about 132,000 tons less than at the end of December, 1924, and about 308,000 tons less than the tonnage being built twelve months ago. It is, however, pointed out that the tonnage on which work was suspended at the end of March, 1925, only amounted to 74,000 tons, as compared with 101,000 tons at the end of March, 1924. The average tonnage being built during the twelve months immediately preceding the war was 1,890,000 tons, *i.e.*, 725,000 tons more than the present total. A slight increase is shown in the tonnage commenced during the quarter, namely:—202,352 tons, as compared with 194,594 tons during the fourth quarter of 1924. The tonnage launched during the quarter—339,120 tons—was 13,509 tons lower than that for the December quarter of 1924. The tonnage of motor ships under construction at the end of March in Great Britain and Ireland—359,920 tons—amounted to about 45 per cent. of the steam tonnage under construction. The total merchant tonnage being built in other countries—1,231,442 tons—was about 58,000 tons more than at the end of December, 1924. The figures for the leading countries abroad are:—Germany, 405,476 tons; France, 187,437 tons; Italy, 164,023 tons; Holland, 119,908 tons; and Denmark, 83,794 tons.

From a table showing the number and tonnage of vessels launched and of vessels commenced in the world during the quarter under review, we learn that 192,618 tons were commenced abroad and 267,101 tons were launched, a decrease of 97,983 tons in the tonnage commenced and an increase of 72,745 tons in the tonnage launched. The total world tonnage under construction—2,396,910 tons—was 1,049,648 tons below the highest pre-war record reached on June 30th, 1913, viz.:—3,446,558 tons. There are at the present time under construction in the world 31 vessels of between 10,000 and 20,000 tons each and 7 of 20,000 tons and upwards. Sixteen out of the 33, and five of the larger vessels, are being built in Great Britain and Ireland. The returns show that there are at the present time 55 steamers and motor ships, each of over 1000 tons, with a total tonnage of 352,143 tons, under construction in the world for the carriage of oil in bulk. Of these tankers, 20 of 122,128 tons are under construction in Great Britain and Ireland, 14 of 121,000 tons in Germany, and 15 of 79,930 tons in Holland.

The tonnage of vessels now being built in the world which are to be fitted with internal combustion engines, amounts to 1,021,631 tons, while the tonnage of steam vessels under construction is 1,357,834 tons. The motor tonnage thus equals over 75 per cent. of the steam tonnage, which shows the remarkable development which is taking place in the adoption of this system of propulsion. In Denmark, Germany, Holland and Sweden the motor tonnage under construction greatly exceeds the steam tonnage; the combined totals for these countries being 142,564 tons of steamers and 522,944 tons of motor ships. The world figures include 96 motor ships each of between 5000 and 10,000 tons; 8 of between 10,000 and 15,000 tons; and 6 of between 15,000 and 22,000 tons.

Of the vessels under construction in the world—excluding vessels the construction of which has not actually been commenced and also all vessels of less than 100 tons—374 of 1,557,657 tons are under the inspection of the Society's surveyors, with a view to classification in Lloyd's Register Book.

ROYAL AIR FORCE CADETSHIPS.

THE Air Ministry announces that a competitive examination for not less than 35 cadetships at the Royal Air Force Cadet College, Cranwell, Lincs., will commence on June 23rd next. The written examination will be held in London and certain other centres in the United Kingdom.

Candidates selected for cadetships as a result of this examination will go through a two years' course at the College, on the satisfactory completion of which they will be granted permanent commissions in the General Duties Branch of the Royal Air Force. This is the first competition to be held under a revised scheme of examination. Under this new scheme candidates other than those nominated by the Air Council and those who have failed at previous entrance examinations, will be required to produce a school certificate, obtained by passing certain examinations. All candidates will be required to attend before an Interview Board at the Air Ministry.

Applications should be made to the secretary, Civil Service Commission, Burlington-gardens, W. 1, and no form of entry will be accepted under any circumstances after April 23rd. It is to be noted that the age limits are now 17½ and 19½ years.

WHEN two sections of the City and South London extension at Collier's Wood met recently, they were only ¼in. out of alignment and ¼in. out in height.

The Railway Results in 1924.

By the continued courtesy of the secretaries to the four British railway companies, we have been enabled to make the following analysis of the respective results for the past year. The figures relate solely to railway operation and do not include anything for any subsidiary business, such as docks, steamers, canals, hotels, &c. All the percentages which follow, except those in Table II., have been worked out by ourselves.

The present annual reports show the traffic receipts and expenditure for 1924 and the corresponding figures for 1923. The Railway Returns for 1923 gave the details of the individual companies for 1913, and presented them under totals for their respective groups. From these two sources we give Table I., which shows the receipts, expenditure and net receipts for 1913, 1923 and 1924, and the increase or decrease of 1914 over 1913 and 1923 and the percentage of the same.

The main items of traffic expenditure in their relation to the traffic receipts were in 1924 as shown by Table II.

In the next table we have divided the respective figures for the maintenance of the track, signals and telegraphs by the mileage of track of running road. This table gives also the maintenance cost of locomotives, carriages and wagons per locomotive, carriage and wagon respectively.

A further comparison of the expenditure of the respective companies is given by the cost per engine mile. This is shown in Table IV., wherein we have included the signals and telegraphs with the track and works, and have added the locomotive running wages, fuel for running, total running expenses and traffic expenses.

The figures in Table V. will be of interest as showing (*a*) how comparatively profitable is the Southern Railway; and (*b*) how uniform are the traffic receipts per engine mile.

Our next table is submitted to show that whilst maintenance was, generally, reduced to suit the fall in receipts the cost of operation grew.

The train and engine mileage during 1924 and 1923 were as shown in Table VII.

Table I.—Traffic Receipts, Expenditure and Net Receipts.

	Traffic receipts.			Increase 1924 over 1913.		Decrease 1924 over 1923.	
	1913.	1923.	1924.		Per cent.		Per cent.
London, Midland and Scottish	46,705,187	78,879,402	78,150,140	31,444,953	67.33	729,262	0.92
London and North-Eastern	34,657,111	58,117,859	56,620,606	21,963,495	63.37	1,497,253	2.58
Great Western	17,782,946	31,773,758	31,489,479	13,706,533	77.07	284,279	0.89
Southern	13,688,940	23,377,800	23,461,683	9,772,743	71.39	83,883*	0.36*
Total for four groups	112,834,184	192,148,819	189,721,908	76,887,724	68.16	2,426,911	1.20

* Increase.

	Traffic expenditure.			Increase 1924 over 1913.		Increase 1924 over 1923.	
					Per cent.		Per cent.
London, Midland and Scottish	29,520,375	64,127,362	64,165,453	34,645,078	117.36	38,091	0.06
London and North-Eastern	22,407,384	47,832,710	48,215,089	25,807,705	115.21	382,379	0.80
Great Western	11,319,645	26,081,434	26,321,445	15,001,800	132.53	240,011	0.92
Southern	8,620,143	18,953,922	19,197,426	10,577,283	121.55	243,504	1.29
Total for four groups	71,867,547	156,995,428	157,899,413	86,031,866	119.71	903,985	0.58

	Net traffic receipts.			Decrease 1924 over 1913.		Decrease 1924 over 1923.	
					Per cent.		Per cent.
London, Midland and Scottish	17,184,812	14,752,040	13,984,687	3,200,125	18.62	767,353	5.22
London and North-Eastern	12,249,727	10,285,149	8,405,517	3,844,210	31.38	1,879,632	18.28
Great Western	6,463,301	5,692,324	5,168,034	1,295,267	20.04	524,290	9.21
Southern	5,068,797	4,423,878	4,264,257	804,540	15.87	159,621	3.61
Total for four groups	40,966,637	35,153,391	31,822,495	9,144,142	22.30	3,330,896	9.52

Table II.—Proportion of Various Items of Traffic Expenditure to Total Traffic Receipts, 1924.

	L.M.S.	L.N.E.	G.W.	Southern
Maintenance and Renewal—				
Way and works	11.10	11.48	14.57	14.20
Locomotives	6.44	7.20	6.84	6.29
Carriages	3.68	3.83	3.62	4.89
Wagons	3.66	5.18	3.12	2.36
All rolling stock	13.78	16.21	13.58	13.54
Locomotive running expenses	20.85	21.24	20.88	20.06
Traffic expenses	28.32	28.95	26.52	23.75
Locomotive running and traffic expenses combined	49.17	50.19	47.40	43.81
Proportion of traffic expenses to traffic receipts	82.11	85.16	83.59	81.82

Table III.—Cost of Maintenance of Track, Signals, Telegraphs, Locomotives, Carriages and Wagons Per Unit.

	L.M.S.	L.N.E.	G.W.	Southern
	£	£	£	£
Maintenance, per track mile of running line—				
Track	447.79	406.39	528.38	579.18
Signals	39.86	48.65	59.63	59.31
Telegraphs	18.47	13.50	22.81	22.71
Maintenance of—				
Locomotives per locomotive	490.74	544.63	538.84	663.56
Carriages per carriage	108.75	102.98	111.99	115.38
Wagons per wagon	9.29	10.48	11.20	15.72

Table IV.—Expenditure Per Engine Mile.

	L.M.S.	L.N.E.	G.W.	Southern
Maintenance and renewal, per engine mile—	d.	d.	d.	d.
Way and works	9.00	9.34	11.37	12.49
Locomotives	5.22	5.86	5.34	5.54
Carriages	2.98	3.12	2.83	4.29
Wagons	2.97	4.21	2.43	2.07
Locomotive running, per engine mile—				
Wages	8.88	9.33	9.05	7.82
Fuel	6.68	6.89	6.34	7.88
Total expenses	16.91	17.28	16.30	17.64
Traffic expenses	22.95	23.5	20.71	20.90

Table V.—Traffic Receipts Per Track Mile, Locomotive and Engine Mile.

	L.M.S.	L.N.E.	G.W.	Southern.
	£	£	£	£
Traffic receipts—				
Track mile of running line	5,531.19	4,707.40	4,949.62	5,575.49
Locomotive	7,627.38	7,564.54	7,880.25	10,544.58
Engine mile	.0338	.0339	.0346	.0367

Table VI.—Increase or Decrease in Expenditure 1924 Over 1923.

	L.M.S.		L.N.E.		G.W.		Southern.	
	Increase or decrease, 1924 over 1923.		Increase or decrease, 1924 over 1923.		Increase or decrease, 1924 over 1923.		Increase or decrease, 1924 over 1923.	
		Per cent.		Per cent.		Per cent.		Per cent.
Maintenance of way and works	− 301,027	− 3.42	− 227,383	− 3.38	− 67	—	− 51,632	− 1.53
,, locomotives	− 69,369	− 1.36	+ 478,510	+ 13.29	+ 30,567	+ 1.44	+ 88,631	+ 6.39
,, carriages	− 301,845	− 9.50	+ 178,505	+ 8.96	+ 5,802	+ 0.51	+ 60,378	+ 5.56
,, wagons	− 173,822	− 5.73	− 462,542	− 13.62	− 6,461	− 0.66	− 22,736	− 3.96
Running—Wages	+ 158,262	+ 1.62	+ 35,533	+ 0.55	+ 45,012	+ 1.25	+ 33,152	+ 1.62
Fuel	+ 222,983	+ 3.46	+ 88,143	+ 1.88	+ 139,211	+ 5.76	+ 192,653	+ 10.14
Expenses	+ 360,078	+ 2.21	+ 243,890	+ 2.07	+ 178,102	+ 2.78	+ 257,535	+ 5.79
Traffic expenses	+ 498,334	+ 2.25	+ 233,227	+ 1.44	+ 180,238	+ 2.20	− 7,197	− 0.13

Table VII.—Train and Engine Mileage.

	Loaded train miles.				Engine miles.	
	Passenger.		Goods.			
	1924.	1923.	1924.	1923.	1924.	1923.
London, Midland and Scottish	86,102,883	84,836,343	55,012,263	54,436,275	231,310,904	226,170,075
London and North-Eastern	59,125,259	58,555,006	40,910,939	41,180,387	167,054,909	166,648,067
Great Western	57,167,706	36,747,904	22,935,965	22,761,037	96,793,512	95,312,545
Southern	39,896,322	59,259,705	6,644,494	6,445,125	64,078,413	62,607,810
Total	222,292,170	219,398,958	125,503,661	124,822,824	559,237,738	550,738,497
Increase	2,893,212		680,837		8,499,241	

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

COLD FLOW OF METALS.

Sir,—The description given in The Engineer of March 27th, page 362, of a pipe nipple which is made fluid tight in a hole bored in a large pipe, by causing the metal of the nipple to flow under mechanical pressure, affords an interesting example of a modern example of cold flow utilisation for attachment purposes.

Since Tresca showed how sheet metals could be converted into superposed tubes, the industrial uses of cold flow have been many.

The nipple described in The Engineer differs from other applications of the cold flow property in that the material required to form the external affixing beadings is provided by forming the nipple originally with corresponding internal beadings. That metal is slowly forced by the mandrel to take the place of metal in the plain cylindrical tube of the nipple, and thereby to displace metal therefrom to form the exterior fixing beadings.

An example of flow of probably similarly constituted metal is

seen in the fixing of a homely device, wherein, however, the flow of the metal takes place rapidly instead of slowly. This is in the mode of attachment of glider domes used for the feet of chair legs. These are attached by placing them over a central piece, and then giving them a blow with a mallet or a lump of wood. The central piece is formed, as seen in the sectional sketch herewith, in the form of a cup A fixed to the chair leg by one screw. In the glider dome B, fixed and held therein by the inturned edge thereof, is a flat plate C, like a washer. The inside diameter of the internal edge of the dome is very slightly larger than the diameter of the cup. The dome is of phosphor bronze, and the cup of softer metal. When the dome is placed over the cup and given a blow by a piece of wood, the cup edge being in contact with C, spreads out circumferentially into the little recess at the inner edge of the dome, and spreading therein firmly fixes it.

April 6th. Wm. F. Offord.

STREET EXPLOSIONS.

Sir,—The alarming street explosions in the manholes of the electric mains, of which we have an instance at Notting Hill, are not new, and it is usually asserted that such incidents are caused by a leakage from adjacent gas mains, no other cause having hitherto been suggested.

I am of opinion that such explosions are due to quite another cause, viz., electrolytic decomposition of water or humidity and the ignition of the resultant gases by short circuit, &c. I am led to this conclusion by the fact that such explosions are always extremely violent—a constant characteristic of the inevitably correct proportions of oxygen and hydrogen produced by electrolytic decomposition.

An explosion of coal gas, on the other hand, might occur at wide variations in the proportions of gas and air. Anything above or below the critical mixture considerably weakens the explosion, which at its best or worst is mild in comparison with the violence of the absolutely correct mixture produced by electrolysis.

To know the cause is the first step to finding the remedy.

W. Love.

London, N. 1, March 26th.

The Zugtelephonic Aktiengesellschaft Berlin has been incorporated, with a capital of 900,000 marks, for the purpose of fitting telephone apparatus to trains on all railways in Germany, thus enabling passengers on any train to speak with a subscriber in any part of the country. It is hoped, states the *Wireless World*, that this service will be opened during the coming summer. When once telephony has been duly installed, it is probable that a radio service will also be set up in the carriages of passenger trains.

Railway Matters.

THE Delaware and Hudson Railway reports that the car shops at Colonie were operated for one year, from March 7th, 1924, to March 7th, 1925, without having to report an accident to any employee; this result was achieved with a force of 450 men working 1,015,000 hours.

THE *Great Western Railway Magazine* for April confirms the rumour as to the Great Western and the London and North-Eastern exchanging engines for testing purposes. One of the "Castle" class of the former company is to be used on the East Coast, and one of Mr. Gresley's 4–6–2 engines is to run on the "Cornish Riviera Express." Preliminary runs are to be made during the week beginning on Monday, April 20th, and the tests themselves will begin on the 27th. Each engine will be manned by a driver and fireman from its own company.

THE report for 1923–24 of the Indian Railway Administration, reviewed in our issue of the 27th ult., showed that 30 passengers and 30 servants were killed in train accidents, as compared with 63 passengers and 21 servants killed during 1922–23; 21 passengers were killed at Pilkhani on October 8th, in a collision caused by twenty-nine wagons running away; 7 were killed on December 12th at Tarki, through a passenger and a goods train meeting on a single line due to an error by a stationmaster. A sudden and unexpected storm caught the rear portion of a mixed train on Ramganga Bridge on March 14th. The last five passenger coaches were overturned and 27 passengers killed.

A LETTER appeared in *The Times* of March 31st pointing out that were the present headlamps of locomotives replaced by strong electric lights, like those on motor cars, the danger of road vehicles being hit by trains at level crossings would be reduced. This communication was answered on the 2nd inst. by Mr. A. W. Arthurton, who pointed out that the headlights on engines are not used for illumination purposes but for signifying to signalmen the classification of the train. We also should like to point out that such a proposal would be most dangerous, as the powerful headlight of an approaching train would so blind the vision of a driver in the opposite direction that he could not see his signals. Such lights are compulsory in the United States, and their evils have to be endured.

THERE is one change we should like to see British railway companies make, and that is to charge, as in the United States, betterments to revenue instead of to capital. For instance, the London, Midland and Scottish charged to capital last year £162,298 for improvements of carriage stock, and £493,135 for improvements of wagon stock; and the London and North-Eastern debited its capital account with £10,735 for steam heating some carriages. The Great Western and the Southern, on the other hand, had no similar entries in their respective capital expenditures. We admit that these are additions to the original capital outlay on the rolling stock, but as they tend to swell the capital account, the question whether revenue should not rather have paid for them demands consideration.

THE first accident of the present year to be inquired into by the railway inspecting officers was that which occurred on January 3rd between Tirphil and Brithdir on the Rhymney section of the Great Western Railway. Continued wet weather culminated in a very heavy rainfall on the 2nd, and some time early in the morning of the 3rd, a length of some 80ft. of the embankment on the down side of the railway slipped into the valley below. As it happened, a telegraph pole was carried away, and the signalman could not get block communication with the next box. He therefore, in accordance with the rules, warned the driver of a goods train on its arrival about 5.20 a.m. that he must proceed cautiously. This the driver must have done, as, according to the guard, the 2 miles 54¼ chains to the slip occupied 17 minutes to cover. But the enginemen apparently had no warning of the slip, and their engine went down the bank, turned right over, and was covered with the wreckage of sixteen loaded wagons. Both men were killed. The length of the train was such that nine wagons and the brake were pulled up by the wreckage, and the guard was able to protect the other road, which had been fouled by wreckage, and then to proceed to the box in the rear. Lieut.-Colonel Mount, who inquired into the accident, considers that the slip could not have been anticipated, but, as regards the subsequent accident, suggested that the rule above referred to should be enlarged so that during the hours of darkness, in fog or falling snow, the section should first be patrolled. This might, perhaps, be limited to certain classes of railway, such as, as in this case, those in mountainous districts.

THE Charing Cross, Euston and Hampstead Railway and the City and South London Railway are shortly to be provided with platform automatic indicators that show the destination and sequence of the next two or three trains, as has been done for nearly twenty years on the main section of the Metropolitan District Railway. The mechanism of this apparatus is very little understood. In each station there is a drum fitted with contactors. As a train leaves the first station of the series—Mansion House or South Kensington, for instance—the signalman turns a pointer to the name of the destination, *e.g.*, Wimbledon, Richmond, Inner Circle, and so on, and presses a button, thereby closing a circuit which electrically operates the corresponding contact maker in the drum at each station in the series, and the next three destinations are illuminated in the indicator, together with the numerals 1, 2 or 3—if, as at the Temple sometimes, only one train has been dispatched, only the numeral 1 is lit up. At the exit of each station one of the track circuit joints used in signalling causes the drum to revolve sufficiently to cancel the indication shown and to cause the numeral 2 to disappear and 1 to be shown, and for 3 to be replaced by 2, and for 3 for the destination of the third train to be shown. It may be of interest to add that the arrangement was never patented. It was so much the work of individuals—engineers of the railway company and of the Westinghouse Brake Company—that no one could claim to have originated the idea. On the railways named in our opening sentence above, the indications will be shown in the signal-boxes, so that the signalmen may know the order and destination of the trains.

Notes and Memoranda.

THE Ontario Legislature proposes to overcome the trouble of glaring headlights on motor cars by limiting the size of the lamps to 21 watts.

DURING the recent tornado in Southern Illinois a 160ft. steel railway span over the Big Muddy River was actually lifted from the piers, being moved 6ft. at one end and 21in. at the other. The steel members were not damaged, as the span was lifted back into place and traffic resumed within a short time. However, there is evidence that the span was actually lifted from the piers, as the rollers were found on the ground around the pier.

THE new power station at Bloemfontein, South Africa, includes some Vickers-Spearing water-tube boilers, each capable of evaporating 25,000 lb. of water per hour and generating steam at 265 lb. per square inch and 600 deg. Fah. The overload is to be 37,000 lb. per hour. The boilers will be fitted with tri-tube cast iron economisers, mounted on top of the boilers, and we believe that this is the first plant in South Africa to be equipped with this type of economiser.

THE Calcutta Improvement Trust has started on a large programme of bridge construction, as the existing steel bridges over the canals system in Calcutta have been found incapable of meeting the requirements of modern heavy traffic. Steps are now being taken to replace these bridges with modern structures three times as wide and capable of carrying heavy loads. The first bridge to be so replaced is at Dum-Dum and is of reinforced concrete. It is an arched structure of the three-hinged type.

IT has been determined by Mr. W. O. Humphery, surveyor to the Walsingham Rural District Council, that harmful bacteria do not live long in water at a depth 26ft. below the surface. In connection with the water supply at a proposed mental home for children, he collected special samples of water from a well. The top water in the well teemed with bacteria in such quantities that they could not be numbered by an analyst, whereas samples of water taken 26ft. below the surface were considered satisfactory, containing only 120 bacteria to the cubic inch.

WE learn from the *Wireless World* that the Transmitters' Section of the Bristol and District Radio Society is conducting a series of tests to ascertain the range of disturbance of an oscillating receiver. Certain members of the Society will send out a specified number of dots at stated times from oscillating receivers, and listeners in the neighbourhood are asked to report to the operator of each station heard, who will, in turn, report to the hon. secretary of the Society. By this means it is hoped to collect some interesting data which will be of service in minimising the oscillation nuisance.

SOME tests carried out in America on the relative strength of several types of brick walls showed that cement mortar walls were about three times and cement-lime mortar walls about twice as strong as wall specimens built with lime mortar. The deformations at design stresses were one-fourteenth as great for the cement mortar walls and one-eighth as great for the cement-lime mortar walls as the deformation in the lime mortar specimens. The average stress at failure was greater for the 8in. walls than for the 12½in. walls. The factor of safety based on the usual building code requirements was 2.4 for the lime mortar walls, 3.1 for the cement-lime mortar walls, and 3.6 for the cement mortar walls.

AN alloy of copper and silicon, known as Everdur, was originally developed by the du Pont Engineering Company, Wilmington, Del., to meet the corrosion problems arising in connection with the use of hydrochloric acid, but it has been found to be resistant to a large number of other corroding agents. It has been in use in the du Pont plants for several years under conditions where corrosion is caused by sulphuric acid, aluminium sulphate, chlorine solutions, lactic and citric acids, the salts of several of the metals, nitric, carbolic, and oxalic acids, and caustic soda. The metal, states a *Times* New York correspondent, is golden in colour and will take a high polish. The cost is comparable with that of high-quality bronzes. It possesses a high tensile strength and elastic limit. The yield point has a value of 56,000 lb. per square inch. The alloy machines readily, makes excellent castings and drop forgings, rolls and draws hot or cold.

FORMERLY the lignite industry in Germany removed dust in briquetting plants either mechanically or with water. As most of these plants are in exceedingly dry districts, it is often difficult to provide enough water for the cleaning machines. The basic principle of the electrical cleaning process, which has been in use for some years, is as follows:—The dust-laden air is conducted at moderate speed past a number of electrodes of different polarity. The dust particles are electrically charged, repelled, and fall on to a conveyor. The dust thus collected is briquetted. In a particular lignite-drying plant of average size, about 0.2 metric ton of dust is recovered per hour, which corresponds to about 8 per cent. of the total factory output. Current at from 30,000 to 250,000 volts pressure is needed. The power consumption is very low and amounts to about 0.7 kilowatt for an air volume of 300 cubic metres—say, 10,500 cubic feet—per minute.

IN an article in the *Bulawayo Chronicle* the author points out that although the almost universal use of the carbide lamp underground to-day is of immense benefit, it is also a source of danger. The writer has proved conclusively, time and again, that the carbide lamp will burn with almost undiminished brilliancy in an atmosphere which will extinguish a candle within sixty seconds. The candle is the safeguard, and when in any doubtful workings as far as the purity of the air is concerned, it is always essential that a lighted candle be carried in addition to the lamp. Actually carbon dioxide itself, so it is stated, has but little effect on a lamp or candle flame, at the same time the extinguishing of such a flame indicates a deficiency of oxygen which always accompanies the presence of this dangerous impurity. Though the candle may not be actually extinguished, the flickering or diminishing of the flame should be sufficient warning that the air is failing, and careful watch should be kept for this when a carbide lamp is also in use.

Miscellanea.

SOME new coal measures are being opened up in the Berrima district of New South Wales. Some of the seams are 7ft. or 8ft. thick.

THE Egyptian State Railways invite tenders for a river steamer, 225ft. long by 32ft. beam and 5ft. draught, with a speed of about 11 miles an hour.

THE prize for the new bridge over Montmorency Falls, Quebec, has been awarded to Dr. A. Surveyer, President of the Engineering Institute of Canada.

THE Canadian Montmorency Power Company announces that it will commence work this spring on a 6000 horse-power development on the River aux Chiens.

THE Birmingham Water Committee has decided to lay a new section, 1¼ mile long, of the third pipe line on the other side of Hagley. The cost will be £50,000.

THE new wire rope works of the Australian Wire Rope Company at Newcastle, New South Wales, are capable of turning out ropes as large as 6in. in circumference and in a single length up to 7 or 8 tons in weight.

THE No. 1 blast-furnace of the Anzan Iron and Steel Works, South Manchuria, has, it is said, established a new record for output. On January 29th the output was 310 tons of pig iron. Blast-furnace No. 2 produced 205 tons on the same day.

IT is proposed to carry out some extensive training works on the river Panchanay, Bihar and Orissa, with the idea of forcing it back into its old channel, which it deserted some thirty years ago. The works will include masonry regulators in the three channels, and will cost at least 1½ lakh of rupees.

TENDERS for the construction of a new dry dock, of slightly larger dimensions than their existing dock, have been called for by the Montreal Dry Dock Company, Ltd. The new dry dock will be built adjacent to the one now in operation, and will provide accommodation for vessels of full canal size dimensions.

ANOTHER German destroyer was raised on April 3rd at Scapa Flow by Messrs. Cox and Danks, after six days' work. This vessel was the first of the eight so far salved to be found. She was lying on her side, and had to be got into an upright position before being lifted bodily. There are still eighteen destroyers to be got up.

THE New South Wales Water Conservation and Irrigation Commission is considering the construction of a dam of 11,922,000 cubic feet capacity at Wyangala, at an estimated expenditure of £1,236,000. Other schemes provide for:—Increasing by 62 per cent. of Lake Cudgellico, £69,000; and the construction of a series of low weirs between Goolagong and Booligal, £125,000.

A GENERAL agency has been established at Lisbon for the purchase of construction materials intended for use in the Portuguese colonies. The materials required are for road and railway construction, new buildings, water and drainage systems, and machinery for other public works. The Government will shortly call for tenders for certain port works to be undertaken at Vilareal de Santo Antonio.

ACCORDING to the annual report of the Dominion Highways Commissioner, 3016 miles of roads in Canada were brought up to modern standards of service during 1924, at a cost of 22,955,862 dollars. Under the Canada Highway Act, Federal aid is extended to the provinces for highway construction. Up to the present there has been paid to the nine provinces, under this Act, 16,784,825 dollars, while additional sums are in the course of payment. At the close of 1924, 5466 miles had been completed under the federal aid system.

IT is announced from Osaka that the scheme to organise a large wireless corporation, as a subsidiary of the Radio Corporation of America, to operate long-distance wireless circuits to foreign countries, has now matured, and the Japanese Government is lending support to the enterprise by placing the powerful station situated at Iwaki at the corporation's disposal. It has not yet been decided whether the other Government wireless stations will be similarly placed at the disposal of the private company. The corporation will be entrusted with the work of extending the wireless service by the erection of additional high-power stations as occasion demands, and will be capitalised at about 20,000,000 yen.

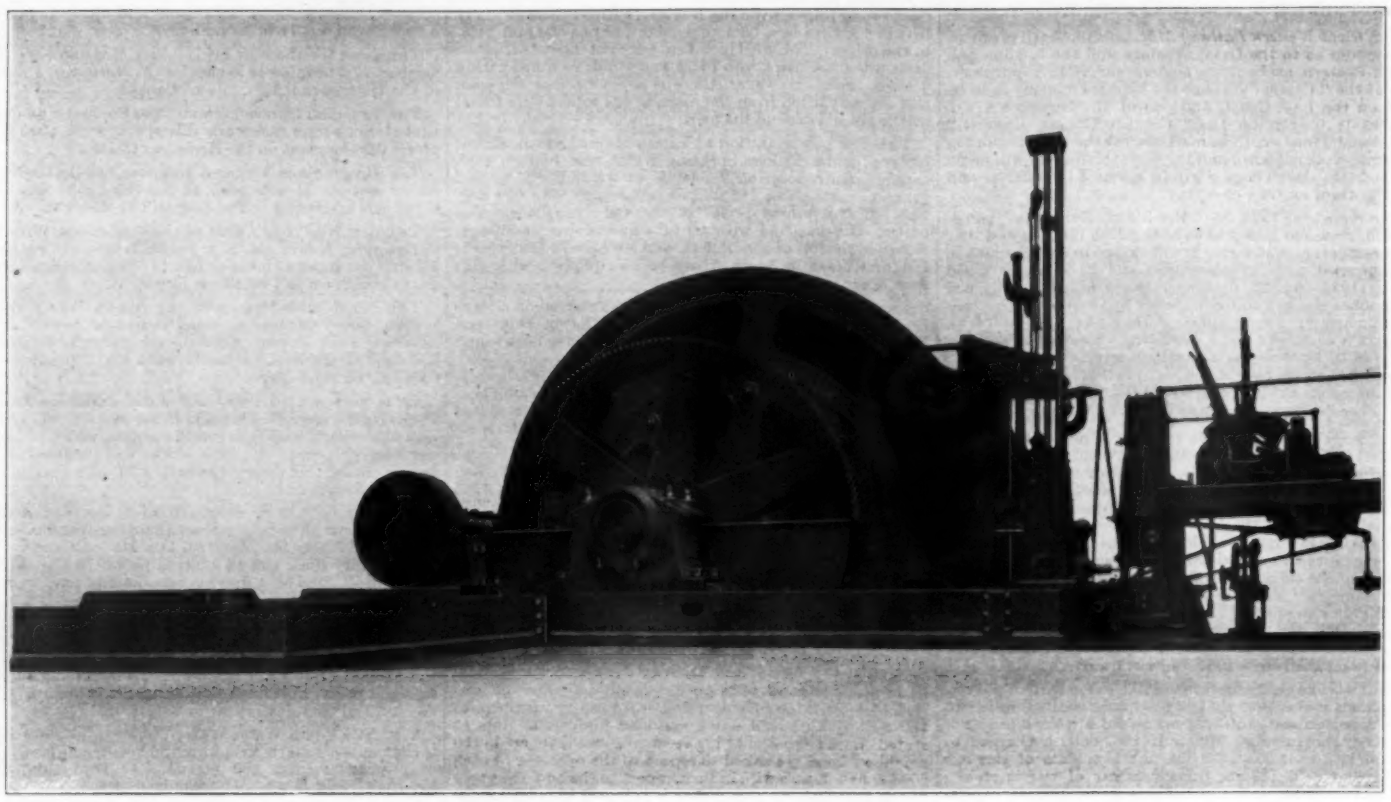
IN view of the failure to reach a satisfactory agreement between the Government and the foreign companies—British, American, German and Swedish—approached in connection with the construction of the long-distance international telephone installations decided upon, it has been decreed that the Italian Administration shall itself undertake the main work. A beginning will be made with the connections between Italy and Austria and Italy and Czechoslovakia. A small part of this work has been allotted to private enterprise, in addition to the telephone systems in certain cities and rural districts. Five companies in all, financed partly by foreign, but mainly by Italian capital, are engaged upon installing systems in the districts allotted to them.

THE damage done to the Post Office telephone wires in Falkirk as the result of a snowstorm which occurred a few days ago was the worst experienced for many years. Nearly 300 subscribers attached to the Falkirk exchange were cut off from telephone communication, in consequence of the wires having been brought down by the heavy weight of the snow, which collected on them. The main telephone and telegraph lines maintained by underground cable naturally suffered no damage, and there is no doubt, as Sir William Noble pointed out, a few years ago, that from this point of view the underground system is greatly preferable to the overhead system. Communication by the overhead lines was interrupted between Falkirk and the junctions of Polmont, Linlithgow, Avonbridge, Shieldhill, Bo'ness, and Grangemouth. As a result of the exceptionally severe snowstorm experienced in the Linlithgow district, considerable damage was done to the telephone poles and wires, and a large number of subscribers were cut off from the exchange and communication with towns in the surrounding district was only obtained after considerable delay.

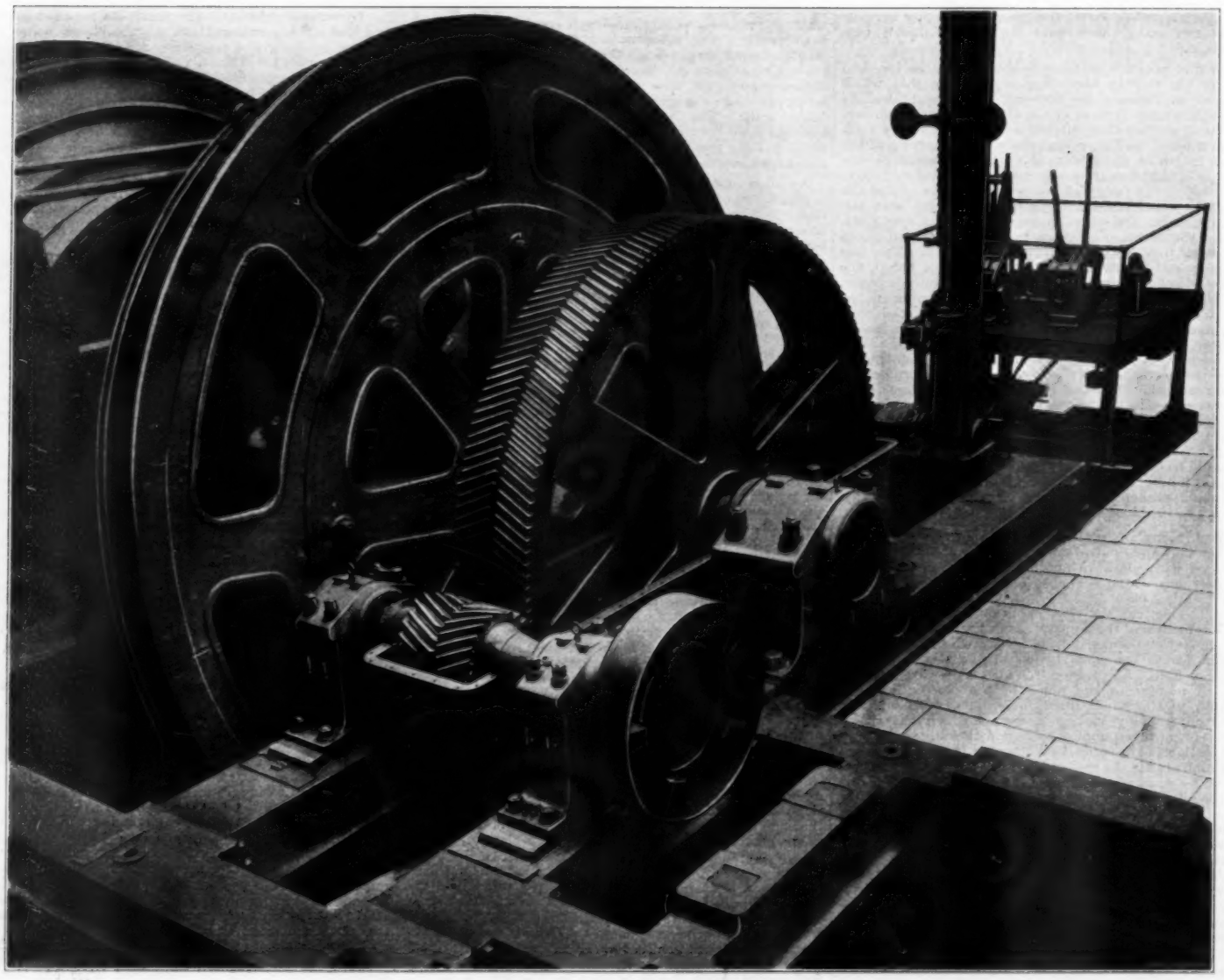
GEARED COLLIERY WINDER FOR CANADA

ROBEY AND CO., LIMITED, LINCOLN, ENGINEERS

(*For description see page 404*)



VIEW OF WINDER WITH DRIVING MOTOR REMOVED



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Half-yearly (including index number) .. £1 12s. 6d.
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If credit occur, an extra charge of two shillings and sixpence per annum will be made.

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Postal Address, 35, Norfolk-street, Strand, W.C. 2.
Teleg. Address, "Engineer Newspaper, Estrand, London."
Telephone Nos. 2258, 2257 Central.

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THE ENGINEER.

APRIL 10, 1925.

A Crisis in the Engineering Industries.

Everyone engaged in the engineering industry knows that it is in a desperate state; more than ten per cent. of the workpeople are unemployed, there are no vacancies in the offices, prices are high, orders are few, and dividends are disappearing. Yet with one accord we have all tried to put a good face on gloomy affairs. "It is," we have said, "no good letting other people know we are depressed, and, in any case, there is so much work to be done in the world that trade must improve before long, and we shall then recover our old position." Whilst there is much to be said for a courageous defiance of adversity and a Micawber-like resolve to rivet our attention on the shining edges of the cloud which proclaim its silver lining, a suspicion is beginning to arise that we are pushing optimism too far, with the result that we are encouraging others to live in a fool's paradise. Even now, after many months of depression, Labour does not appreciate the real condition of British industries. It sees as much display of money as ever; the shops in our great streets are as bright as of yore, our places of amusement are still crowded, the sports industries and the pleasure motor car industries continue to flourish, we manage to pay about one-quarter of our incomes to tax collectors, rate collectors and revenue officers, and we still find means of paying the dole to all those who can't or won't work. How is it possible that we can do all these things and be approaching the brink of bankruptcy? It is not surprising that that question should be asked and that a large proportion of the adult population refuses to believe that the industrial position of the country is precarious.

It is not improbable that appreciation of the need of correcting this fallacy led the British Engineers' Association to publish the pamphlet which lies before us. It is entitled "Report on the Present Condition and Future Prospects of the Engineering Industry," and it was compiled for presentation as evidence to the Government Committee on Industry and Trade. Unfortunately, the price of the document is seven shillings and sixpence. Many will make that sufficient excuse for not reading it, and it is to be feared that the general public will never study the depressing facts and figures it contains and will continue to believe that the industries of the country are not really in a bad way. It consists in part of a large number of statistical tables compiled from particulars given in the *Board of Trade Journal*, with charts and diagrams, and in part of a description of the state of the engineering industries. The material placed before the reader summarises many facts which are not otherwise readily available and presents a gloomy picture. Let us consider a few examples. The year 1913 is taken as the datum. In 1920 we exported iron and steel, ships, vehicles, machinery and other metal and engineering products to a value but little more than 80 per cent. of that of 1913; in 1923 the figure fell to 76 per cent., and last year rose again to no more than 79.2 per cent. Price values are not very satisfactory criteria, even after adjustment, but the figures for weight of machinery exported only serve to exhibit a worse condition. As compared with 1913, the export of machinery expressed in tons in 1920 fell to 67 per cent., in 1923 to 62.7 per cent., and in 1924 had risen only to 67.3 per cent. Figures which may be usefully correlated with these percentages are those which show the rate of employment in several industries. In 1924 the percentage in engineering was 86, in the iron and steel industries 78, and in shipbuilding 70. In a rough-and-ready way we may conclude from these figures that for an output by weight of 67 per cent. or so we had to employ about 78 per cent. of our labour. In other words, we had a fall of roughly 14 per cent. in output per unit of labour. The figure has no pretence to accuracy, but it is rather interesting that it should so closely approximate to the reduction of 12½ per cent. in working hours. We shall burden our readers here with only a few more figures. Comparing 1913 with 1923, the report tells us that "earned profits fell from 11.8 per cent. to 5.7 per cent. and dividends from 7.6 per cent. to 4.9 per cent., whilst the proportion placed to reserve decreased from 3.5 per cent. to 0.9 per cent." We are not surprised that the report should add: "Under the conditions now existing, the engineering industry offers no attraction to the new capital required for its progressive development;" its present tendency is retrogressive. Enough has now been said to show that if a bitter tonic was required to stimulate industry the report before us provides it. Let us now glance at its views as to the causes of the situation in which we find ourselves and the means of removing them. It does not think that our engineering industries can be charged with incapacity or inefficiency on the technical side, but there is "considerable room for improvement in trade propaganda and publicity at home and abroad." The trouble is the result of high costs of production and distribution, which is followed by effective foreign competition, both at home and abroad. We reprint on page 415 the long summary in which the report reviews the Primary Causes of the Present State of Industry and Trade, and need say little about it here. There is nothing in it with which we do not heartily agree and nothing which has not been said a thousand times already; yet it is useful to have it in this succinct form. When it arrives at a consideration of the future prospects of the engineering industry, the report can do little more than urge us to remove the causes of our decline which it has already enumerated, but it does warn us not "to drift along on our present course in the belief and expectation that we will be saved from disaster by political and economic follies of our rivals causing their selling prices to rise to the same level as our own." It sees our only hope in reduced costs of production and distribution and on the willing co-operation of capital, administration and labour, and it fears that unless something is done, and done quickly, "the future prospects of the engineering industry in this country will give cause for the gravest concern."

The British Engineers' Association deserves the thanks of all engineers for the preparation and publication of this report. A vast amount of work is represented in the compilation of the tables and the production of the charts. Few people have time or inclination to wade through Board of Trade returns and summarise the salient points. Yet it is only by making the really important facts emerge from a mass of detail that we can see the state of trade in its proper light. By enabling us to get this clear vision the Association has done admirable work, and we trust that means will be taken to bring the report before the general public and particularly before the workmen in the engineering industries. A few days ago Colonel Lithgow, when addressing the Commercial Committee of the House of Commons, ventured to suggest that "we are suffering much more from sentiment in industry than from ill-will. Sentimental standards, not supported on any economic basis, cannot survive. If we are as a manufacturing nation to obtain our fair share of work in the world's markets we must revise our own notions of what industry can yield unless we can exercise such influence as will raise the standard of life and conditions in competing countries." Colonel Lithgow was referring specifically to the shipbuilding industry, which is in a

much worse state than the general engineering industry, but his words are applicable to all the trades of the country. Much as we may desire to see the standard of life raised, it is quite obvious from the result of our experiments in that direction that it is, in the present conditions of the world, impossible. The high labour costs per unit of product that have prevailed during the past few years cannot be maintained, and if we are to recover our economic position we must find means of lowering them. Longer hours, keener work, less restriction on output are the only means by which we can hope to meet foreign competition. We agree with the British Engineers' Association that to wait for foreign labour costs to rise to a point equal with our own is a suicidal policy; our position is too critical for delay. Immediate action is needed, and the only sound course open to us is to bring down the labour costs per unit, both by working harder and by adopting all those means for the reduction of labour costs which are known to engineers. We trust very sincerely that the conferences which are now taking place between employers and employed in the engineering industry, and in which we rejoice to note an unusual degree of mutual sympathy, may lead to the evolution of a policy that will re-establish our engineering trades in the markets of the world.

The Railway Year.

On another page we give our usual annual summary of the results of the working of British railways. The figures are based on the returns of the four grouped companies, which, judged by the 1923 figures, form 97 per cent. of the British railway system. We have compared the receipts, expenditure and net receipts with those of 1913, as well as with 1923. Remembering that the Railways Act, 1921, practically guaranteed to the companies an annual net revenue equivalent to the aggregate net revenues of 1913, it is interesting to observe how greatly the expenditure has grown and how disproportionate are the receipts. Whilst the receipts of 1924 were 68.16 per cent. greater than those of 1913, the expenditure was 119.71 per cent. more, with the result that the net receipts fell by 22.30 per cent. Perhaps, before going further, we ought to point out that we are only concerned with the working of the railways alone and have taken no account of the "other businesses" with which the companies are identified. When 1924 is compared with 1923, it is seen that there is a decrease of 1.26 per cent. in the receipts, an increase of 0.58 in the expenditure, and a decrease of 9.52 per cent. in the net receipts. Of the four grouped companies, the London and North-Eastern suffered the most. Its decrease in traffic receipts amounted to £1,497,253 and its increase in expenditure to £382,379. Mr. Whitelaw, the chairman, anticipated that £1,150,000 of the former figure were lost by the reduction in the amount of coal carried. Added to this deficit there was a loss of £2,400,000 owing to reduced rates and another of £600,000 which resulted from the railway strike of January and the dockers' strike of February. These two figures make three millions, and as the total decrease was only half that sum it would seem that had there been no reduction in rates and no strikes the London and North-Eastern would have enjoyed an increase in receipts of one and a-half million pounds instead of a decrease of that amount. Similarly, the London, Midland and Scottish claims to have lost nearly three millions by the reductions in rates, for it carried 1,600,000 more tons of general merchandise. That company's loss upon coal traffic was less severe than its neighbour's, being only £587,000. On the whole, then, the companies did not do badly last year in the amount of traffic they secured. Whilst the reduction in coal traffic is to be regretted, it must be borne in mind that it was mainly brought about by the situation in the Ruhr becoming easier. That was no little compensation. The losses the companies have made owing to their lowering of the rates may have been bad for the companies, but must have been of benefit to trade, and whenever trade has a fillip the railways share in it. In passing we would observe that Mr. Whitelaw justified the withdrawal of £2,750,000 from the compensation fund because "the Railways Act provided that fund for the very purpose, among others, of helping, by the reduction of rates, the re-establishment of the nation's trade."

It is the growing expenditure that gives us most concern. Last year not only did the receipts of the four groups fall by nearly two and a-half million pounds, but expenditure rose by nearly one million. Now, the railway and dock strikes occurred respectively in January and February—that is to say, at the beginning of the year, and if we turn to the tables of expenditure we may see what economies each department effected in the subsequent months. Table VI. of our article gives us the figures we want; from them it will be seen that in maintenance and renewal of way and works and of wagons a reduction was effected on each railway. The London, Midland and Scottish secured an economy, too, in the upkeep of locomotives and carriages, and whilst the Great Western registered an increase in both the latter items, it was only a small one. The advance of £478,510, or 13.29 per cent., on locomotive maintenance and renewal account of the London and North-Eastern was apparently caused by the expenditure of £419,668 out of revenue on new locomotives. As was to be expected, both locomotive and carriage expenditure on the Southern increased, and it is remarkable that all the companies spent more money in 1924 than in 1923 on enginemen's wages, fuel, running expenses generally and in traffic expenses. Table VII. in our article shows that, except in goods train mileage on the London and North-Eastern, all the companies have an increased loaded train mileage and engine mileage to their credit. By the increase in the price of coal by about 4s. per ton the rise in the bills for fuel and running expenses is explained. But the reason for the higher wages bill and the rise in traffic expenses is not clear, and it does seem that therein is a field which might be productive of economies. A remark made by Sir Guy Granet, at the London, Midland and Scottish meeting, suggests that the increased passenger receipts brought by the Wembley traffic were earned hardly. The company took about one million pounds gross revenue from that traffic, but on the whole it was unprofitable, for it not only imposed a great strain on the company's resources, but forced it to divert other traffic, on a large scale, from its accustomed and economic routes so as to keep the line clear for the special Wembley trains. The Wembley traffic was essentially long-distance business; the bulk of it came from the Midlands and the North. The diversion of the ordinary traffic to longer routes immediately increased the length of haul and the coal expenditure. Moreover, the longer route had often lay over an inferior road as regards gradients, and thus the load had to be decreased or the trains had to be double-headed. It is fair, therefore, to assume that not only trainmen, but signalmen, gatemen, the platform staff and other grades cost more in wages owing to overtime, &c., or in relief. The increases under the heads to which we have called attention are, it is true, small, but they are noteworthy in that they are the only items in which a decrease has not accompanied the fall in receipts. The matter, furthermore, is of importance because it is in running and traffic expenses—which between them take nearly 50 per cent. of the receipts—that the companies are threatened with a higher wages bill. Whatever defence there may be for the eight hours' day falls to the ground in those cases where the work is not continuous. Now, for many railwaymen, even enginemen and signalmen, the work is not continuous. Yet each and all have an eight hours' day—the porter on the branch line, with four or six trains a day, just as much as the man in a busy terminus, whilst the signalman on a single line is just as well off, in that respect, as his fellow in a junction box. What aggravates this feature is that the establishment of the eight hours' day was not of the companies' doing; it was set up in November, 1918, by the Government during its control of the railways and without even asking the companies for their views. Many things were done by the Government to placate and conciliate labour during the control period, but nothing worse than that rash undertaking. It placed a burden on the companies—and therefore on the trade of the country—that can never entirely be thrown off and which will cripple the railways for some years to come.

The men are not, however, content with the eight hours' day and the other benefits that the Government, with other people's money, gave them. They have put forward an "all-grades programme," the granting of which would cost the London and North-Eastern, for example, nine millions a year to meet the advances in wages asked for and four millions for the improved conditions of service, whilst over seventeen millions would be wanted for the men on the London, Midland and Scottish. The companies have not only refused these demands, but have lodged counter proposals for reductions in wages. From what we have shown it will be clear that, although the counter propositions may not be justified, there is no sound reason yet for either higher pay or better conditions. Happily, means exist for the adjustment of these points. The whole question is being discussed between the companies and the men, and we have the word of Viscount Churchill, at the Great Western meeting, that the discussions have been of the most friendly character. Any points in dispute will go to the Central Wages Board and, failing agreement there, to the National Wages Board, on which are representatives of the public. That last is an important feature, as under the terms of the Railways Act, already referred to, it will probably be the public which will have to pay. Fortunately, the feeling of conciliation is in no trade more strong than on the railways, and the happy relations that generally have characterised the discussions between the railway companies and their men will, it is to be expected, bring some satisfactory solution in this case.

Obituary.

SIR WILLIAM MITCHELL ACWORTH.

Sir William Mitchell Acworth, who died, in his seventy-fifth year, on April 2nd, shone pre-eminently as a writer on the economic aspects of railway subjects. The International Railway Congress of 1895 was held in London, and first brought him into prominence in railway circles. He was the secretary of the local section, and for the first time the Railway Congress and its purpose were understood and appreciated in this country. The great success of that meeting was almost wholly due to Acworth's ceaseless energies and excellent management. It may here be observed that he was a delegate of the British Government at each of the four Congresses since 1895.

Sir William always confined himself to economical questions, and did not attempt to deal with technical matters. Thus, his membership of the Lord James Royal Commission of 1899 on Accidents to Railway Servants did not afford much scope for his abilities. He was far more at home and much more useful in the support he gave to Sir George Gibb in the absorption by the North-Eastern Railway of such American methods as the use of big wagons and long trains, and the adoption of ton and passenger mileage statistics. The campaign conducted by the Hon. George Peel for the general use of those figures appealed to him, and naturally, when Mr. Lloyd George signalised his arrival at the Board of Trade by numerous inquiries into railway administration and made railway accounts and statistics a subject for investigation, Acworth was appointed a member of the Departmental Committee which conducted the inquiry. The railway companies were, however, too strongly entrenched, and Acworth was one of the minority that considered ton-mileage statistics to be necessary. Simultaneously, he was on the Vice-regal Commission on Irish Railways, and found himself again in the minority. But on that occasion he was in the good company of Sir John Aspinall. He was not a member of the Lord Loreburn Royal Commission of 1913–14 on the Relations between Railways and the State, but gave valuable evidence. In 1916 he, Sir Henry Drayton and the late Mr. A. H. Smith formed a Royal Commission to inquire into railways and transportation in Canada. In that case, Mr. Smith was in the minority, but we have always thought that had his views been put into force, the Grand Trunk would have won through, and the Canadian Pacific would have had to compete with a private concern instead of with Government-owned and worked railways.

In 1918 Acworth went to Rhodesia, and straightened out some troublesome problems there, but his greatest work yet remained to be done. It was the inquiry in 1920–21 into the administration of the railways of India. Railway officers, traders and the general public in India will always have cause to remember the wisdom and courage shown in the report that followed that investigation. It resulted in railway finance being separated from public expenditure, and the railways being given a freer hand. They were recommendations, too, that gave a lead to Sir Sam Fay and Sir Vincent Raven when they met with fairly similar conditions in New South Wales and New Zealand. For that great work Acworth received the K.C.S.I. in 1922. A yet more difficult undertaking, and his last big task, was the reforms made in 1923 in the administration of the Austrian railways, whereby they have been established on a paying basis.

Besides these public services, mention must be made of the help he frequently gave to the United States Inter-State Commerce Commission; and notably when the late Senator Newlands held his inquiry in 1917. From the little we have said, it may be assumed that Acworth was usually in the minority. Actually, he was generally found championing causes that were being attacked. If hard things were said of the railways, he would come to their help; if traders complained, and the railways challenged the charge, he would tell the companies that they did not know what it cost to run their business. It was safe in those days to say that if an opportunity presented itself

to preach the gospel of ton and passenger mileage statistics, Sir William would seize it. The short stay of Sir Eric Geddes in the political field and the formation of the Ministry of Transport secured the adoption of those figures, but their best friend cannot yet say that they have proved to be as invaluable as their advocates anticipated.

Sir William was a man of great charm, and, despite his attacks on railways and traders alike in turn, never made an enemy.

ARTHUR JACOB.

ARTHUR JACOB had many friends amongst engineers, and they will hear with regret of his death on April 3rd at the comparatively early age of fifty-seven. His professional career may be regarded as starting from his association with Dr. S. Z. de Ferranti at the Grosvenor Gallery and Deptford in 1884. That association caused him to follow the electrical industry, and he subsequently became engaged in the construction and management of electrical undertakings. He was resident engineer on behalf of the British Thomson-Houston Company, Ltd., for the complete electrification of the Dublin United Tramways Company's system, work which included the erection of two power stations and sub-stations and the electrical equipment of over 42 miles of track and 300 cars; manager of the British Schuckert Electric Company's business in London; and manager of the central station department of Siemens Bros. Dynamo Works, Ltd., of London and Stafford. In 1908 Mr. Jacob became manager of the British Aluminium Company, Ltd., and he held that position at the time of his death. He was largely responsible for the development of the use of aluminium for industrial purposes in general and for electrical purposes in particular, and had taken a leading part in the formulation and carrying into effect of the Loch Aber hydro-electric scheme. In addition to his work with the mother firm he was also charged with the direction of certain of the Aluminium Company's subsidiary undertakings. Mr. Jacob was a member of the Institution of Electrical Engineers, of the American Institute of Electrical Engineers, of the American Electrochemical Society, and of the Institute of Metals. He was also a member of the Executive Committees of the British Engineers' Association and the Federation of British Industries.

Literature.

The History of the Telephone in the United Kingdom. By F. C. G. BALDWIN, with a foreword by FRANK GILL. London: Chapman and Hall. Price 42s. net.

THOSE who are connected with telephone engineering, and possibly many others as well, will be grateful to the author of this volume for bringing together so many interesting facts concerning British telephone development, which, although according to recent reports still leaves a good deal to be desired, has had a marked influence on business operations, and which directly or indirectly has proved a great help to practically everyone. It is not easy to give in a few hundred words an adequate idea of the real character of this book. Although it does not trace in detail the history of communication prior to the introduction of the telephone, it deals with the progress which followed Graham Bell's invention far more thoroughly than any other volume on telephones that has come to our notice.

So far as the United Kingdom is concerned the entry of the telephone may be regarded as beginning in the year 1878, and it might be thought that within that comparatively short time records essential to the compilation of a complete history would still remain in existence and that the task of writing a book of this nature would not present great difficulty. But as regards technical matters, apparently this has not been the case. During the nine years' *régime* of the United Telephone Company, when master patents were in force, owing largely to the patent situation and legal considerations arising out of the possibilities of infringement, an atmosphere of extreme conservatism and exclusiveness appears to have been created. Officers of the company, the author states, were denied the privileges accruing from membership of the Institution of Electrical Engineers and were actually forbidden even to attend its meetings. As a natural consequence during the time the United Telephone Company operated—from 1880 to 1889—the dearth of telephone technical literature was particularly marked, and it is only within comparatively late years that the subject of telephony has begun to assume its rightful place in literature and in the proceedings of the Institutions which exist for the advancement of engineering science.

Nevertheless, Mr. Baldwin gives a great deal of early history and technical details of the first instruments that were originally used and pictures of the pioneer telephone exchanges. In an early part of the book there is a short list of some of the subscribers to the first telephone exchange at 36, Coleman-street, E.C., which belonged to the Telephone Company, Ld. (Bell's patents), floated on June 14th, 1878. The technical information relative to this exchange and the instruments used by the subscribers makes interesting reading. In subsequent chapters the author has a good deal to say about other early exchanges, which, as illustrations indicate, were designed on very different lines from those in operation to-day. Careful attention has been given to the arrangement of the various chapters with a view to giving a more or less connected narrative and to the division of the subject into suitable sections.

The first three chapters follow consecutively in datal order, but in subsequent parts of the volume subdivision has been deemed to be necessary and the commercial and technical aspects of telephony are dealt with in separate chapters. After the third chapter, dealing with the activities of the United Telephone Company in London from 1880 to 1889, the author deals with the introduction of telephony into the provinces, this section covering the years 1879–1886. He then considers the early use of telephones by the Post Office between the years 1881–1888, the United Telephone Company and the provincial subsidiary companies operating between 1881 and 1890, and the introduction and early development of the multiple switchboard between 1883–1889. In another chapter he considers the early underground cable systems for telegraph and telephone circuits, and shows that the origin of all our present-day systems of underground conductors for electrical purposes was an experimental underground line laid by Sir Francis Ronalds in his private garden at Hammersmith in the year 1816.

This section of the book deals with underground cable systems between the years 1823 and 1890 and is followed by chapters on the activities of the National Telephone Company, Ld., in London and the provinces between 1884–1912. A good deal of space is then devoted to various forms of multiple switchboards in use between 1890 and 1912. Up to the former date valuable experience had been gained in the practical working of multiple switchboards in a few exchanges and the manipulation of telephone traffic by the means of these boards was closely studied by engineers in this country and America; but in consequence of the impossibility of dealing in a volume of this kind with all the different types of switching plant that have been introduced, the author only considers some of the prevailing types of multiple switching appliances.

A chapter on the introduction and development of dry core paper insulated cable covers the progress of such cables between the years 1890–1912, and concludes with some interesting information on the termination of dry core paper cables. The author contends that in spite of all the attention that has been paid to this question during the thirty-three years that dry core cables have been in use, it still remains a problem for solution to-day, for no means of termination which can be regarded as in every way satisfactory for either outdoor or indoor purposes has so far been evolved.

In a chapter on the introduction and early development of the common battery system it is shown that the first common battery multiple switchboard to be installed in this country was at the Woolwich works of the Western Electric Company, and it was erected as a demonstration model for the purpose of illustrating in a practical manner to engineers of the National Telephone Company, the Post Office and others interested, the principles of operation of a common battery exchange. Other sections of the volume are devoted to municipal telephones, the Post Office in London and the provinces, overhead line plant, transmission, long-distance communication, automatic or machine switching systems, legislation, &c. Although certain links in telephone development are not included, for reasons beyond the control of the author, the volume is probably as complete as it was possible to make it, and will no doubt be read with interest by a great many telephone engineers.

BOOKS RECEIVED.

Sul cosiddetto Coefficiente di Sicurezza degli Aeroplani. By E. Pistolesi. R. Scuola d'Ingegneria, Pisa. No. 7. Settembre, 1924.

The Mechanical Investigations of Leonardo da Vinci. By Ivor B. Hart. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 16s. net.

Practical Advice for Inventors and Patentees. By C. M. Linley. London: Sir I. Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 3s. 6d. net.

Reinforced Concrete Bridges. By W. L. Scott, assisted by C. W. J. Spencer. London: Crosby Lockwood and Son, Stationers' Hall-court, Ludgate-hill. Price 42s. net.

Willis' Workmen's Compensation Acts. Twenty-third edition. By W. Addington Willis. London: Butterworth and Co., Bell-yard, Temple Bar, W.C. 2. Price 15s. net.

The Construction of Wells and Bore-holes for Water Supply. By J. E. Dumbleton. London: Crosby Lockwood and Son, 7, Stationers' Hall-court, Ludgate-hill. Price 10s. 6d. net.

Cleveland Institution of Engineers: Proceedings, December 12th, 1924, and January 12th, 1925. Middlesbrough: The Office of the Cleveland Institution of Engineers, Corporation-road. 1925.

Annales des Ponts et Chaussées, Partie Administrative. Fasc. 1. Janvier–Février, 1925; and *Partie Technique*. Fasc. 1. Tome 1. Janvier–Février, 1925. Paris: A. Dumas, 6, Rue de la Chaussée-d'Antin.

The Modern Soap and Detergent Industry: Vol II., Manufacture of Special Soaps and Detergent Compositions. By Geoffrey Martin. London: Crosby Lockwood and Son, Stationers' Hall-court, Ludgate-hill, E.C. 4. Price 36s. net.

"*Proceedings*" *of the Twenty-seventh Annual Meeting of the American Society for Testing Materials.* Part I., Committee Reports; Part II., Technical Papers. Philadelphia: American Society for Testing Materials, 1315, Spruce-street.

SIXTY YEARS AGO.

IN our issue of April 7th, 1865, we described and illustrated a curious invention—there is no evidence that at that date it had yet been tried in practice—known as Lefroy's Fuel Power. The invention consisted of a steam engine, a boiler and a fuel-feeding arrangement, and its object was to secure the combustion of the fuel under high pressure and the utilisation of the high pressure products of combustion to assist the steam in the engine cylinder. The fuel used was petroleum alone or mixed with large or small particles or balls of patent fuel. The fuel was introduced through a series of three pressure locking chambers into the furnace. The furnace was an elongated vessel completely enclosed within the water-and-steam vessel of the boiler. At the foot of the furnace a jet of compressed air was delivered from an auxiliary cylinder in line with and driven by the main steam cylinder. The top of the furnace vessel was open and projected above the water line in the water-and-steam vessel. The products of combustion were not, however, allowed to escape direct into the steam space. A bell-shaped shell was placed over the opening at the furnace top, and caused the products of combustion to travel down into the water outside the furnace. Emerging round the lower lip of the bell, the products passed upwards through the water to join the steam in the steam space. The steam and gases thus united were led to the steam cylinder. At first sight, the modern reader might be forgiven if he thought that in this invention he had come across an anticipation of the Still engine, but on examination it is found to bear a much closer relationship to the recently revived proposal to generate steam by the direct combustion of fuel injected into the water. Much was claimed for the invention—presumably by Mr. Lefroy. It was held that it opened "a cheering prospect of abolishing the tens or hundreds of thousands of chimneys which now pour into the atmosphere of our large cities those masses of filthy and noxious smoke which encompass them and begrime their populations and buildings." It was farther held that the invention would reduce "by 90 per cent. the expenditure of the fuel requisite for all purposes, whether of mechanical power, of the industrial arts, or of domestic comfort, luxury and elegance." We invited our readers' opinions on the practicability of the invention. In a succeeding issue one correspondent stated that an engine on the same principle as Mr. Lefroy's had been tried in America, and had, he believed, shown "very excellent economical results." But the arrangement was open to the fatal objection that the boiler became choked with soot and ashes every two or three days.

IRON AND STEEL INSTITUTE.

As already announced, the annual meeting of the Iron and Steel Institute will be held at the Institution of Civil Engineers, Great George-street, Westminster, on Thursday and Friday, May 7th and 8th, 1925, beginning each day at 10 a.m. The annual dinner will be held at the Hotel Cecil, Strand, W.C., on the evening of Thursday, May 7th, at 7 for 7.30 p.m.

The following programme has been arranged:—On the Thursday, at 10 a.m., there will be a general meeting of members, when the Council will present its report for the year 1924, and the hon. treasurer will present the statement of accounts for 1924. The Council will then be elected, and the newly elected President—Sir Frederick Mills, Bart.—will be inducted into the chair. After presenting the Bessemer Medal to Professor Thomas Turner, the President will deliver his presidential address, after which a selection of papers will be read and discussed (Nos. 7 and 8). At the afternoon session papers Nos. 12, 13, 1 and 10 will be read and discussed. The annual dinner of the Institute will take place in the Grand Hall of the Hotel Cecil, Strand, W.C., a 7 p.m.

On the Friday, at 10 a.m., the award of the Andrew Carnegie Research Scholarships for 1925-6 will be announced, after which a selection of papers will be read and discussed (Nos. 5, 9, 11, 14 and 3).

The following is a list of the papers offered for the meeting:—(1) L. Aitchison and L. W. Johnson, "The Effect of Grain upon the Fatigue Strength of Steels"; (2) H. von Eckermann, "A Method for Reducing the Percentage of Phosphorus in Swedish Iron by Diminishing the Phosphorus in the Charcoal"; (3) B. D. Enlund, "On the Structure of Quenched Carbon Steels"; (4) G. Watson Gray and C. D. Garbutt, "Estimation of Phosphorus in the Presence of Vanadium"; (5) R. H. Greaves and J. A. Jones, "Temper Brittleness of Steel: Susceptibility to Temper Brittleness in Relation to Chemical Composition"; (6) W. T. Griffiths, "Note on Nitrogen as a Possible Factor in Temper Brittleness"; (7) T. W. Hand, "Progress in British Rolling Mill Practice"; (8) A. Hultgren, "'Flakes' or 'Hair Cracks' in Chromium Steel, with a Discussion on 'Shattered Zones' and 'Transverse Fissures' in Rails"; (9) D. H. Ingall and H. Field, "'Peeling' in White Heart Malleable"; (10) A. G. Lobley and C. L. Betts, "The Influence of Gases at High Temperatures upon Iron, with special reference to the Formation of Blow-holes"; (11) R. L. Smith and G. E. Sandland, "Some Notes on the Use of a Diamond Pyramid for Hardness Testing"; (12) T. Henry Turner and J. D. Jevons, "The Detection of Strain in Mild Steels"; (13) J. D. Jevons, "Strain Detection in Mild Steel by Special Etching"; and (14) J. H. Whiteley, "Observations on Martensite and Troostite."

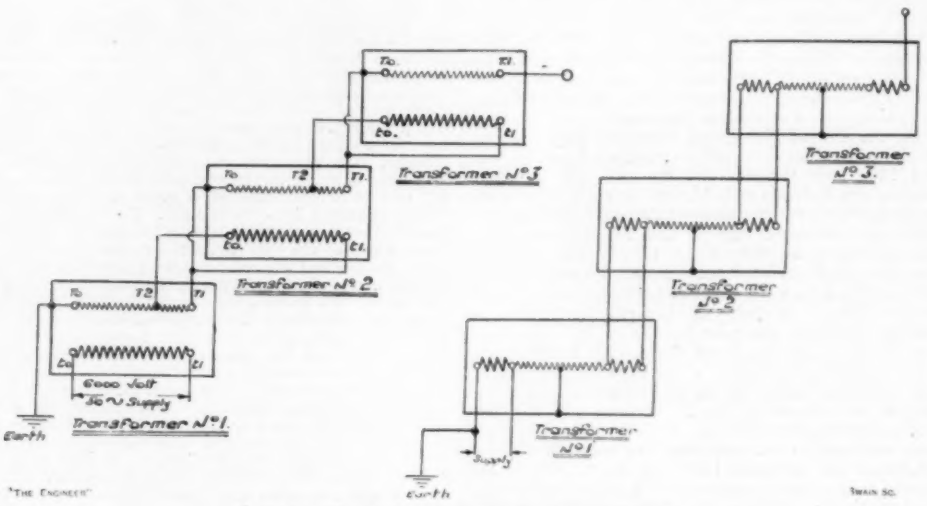
Million Volt Testing Equipments.

THE news has just reached us that in order to solve the problems of high-voltage transmission well in advance of actual requirements, the Leland Stanford University of California has ordered a two million-volt testing equipment from the General Electric Company of America. Operating at the highest pressure ever produced at the commercial frequency of 60 cycles per second, the apparatus will produce a spark across a gap formed by two needles, spaced 17ft. apart, and it will be installed in a special laboratory set aside for extra high-pressure work. Investigations relating to high-voltage phenomena have, of course, been going on in America for some considerable time, but the proposal to carry out experiments at a pressure of two million volts surpasses anything that has hitherto been attempted.

Having regard to the fact that pressures up to 220,000 volts are at present used abroad, and that 110,000 and 150,000 volts are common, British manufacturers are also very wisely giving attention to the design of high-voltage testing equipments, which must, of course, be capable of producing pressures considerably in excess of those actually in use. A few weeks ago Ferranti Ltd., of Hollinwood. Lancs., announced that a pressure of a million volts had been produced in the company's works, and through the courtesy of Mr. E. T. Norris, the firm's chief designer, we are able to give particulars of these high-pressure tests, which have now become an industrial necessity. Electrical apparatus suitable for a working pressure of 145,000 volts requires test pressures up to at least 500,000 volts, whilst experimental and development work demands still higher pressures. In the design of testing transformers to meet these requirements the insulation problems are naturally more difficult to deal with than those that are met with in the design of ordinary transformers, for voltage stresses three or four times greater than usual become normal. Experience gained in the construction of the testing units is directly applicable to the design of power transformers; in fact, it has influenced to a large extent the design of power units working at pressures as low as 6600 volts. Part of the duty of a testing equipment, it is to be remembered, is to puncture insulation and flash-over insulators and spark gaps, thus practically short-circuiting the high-tension windings, and these abrupt changes in the electrical circuit conditions, set up transient voltages and high-frequency oscillations which may cause abnormal stresses in parts of the winding. Voltages between the turns and coils of a transformer winding of ten to twenty times normal have, in fact, actually been measured, but transient effects may be very considerably reduced by protective devices and by suitably proportioning the internal inductance and capacity relations of the windings.

Many single-unit testing transformers for voltages up to 500,000 have been built by Ferranti Ltd., and it is possible to construct units for higher pressures, but for voltages above 350,000 the cost of a single unit transformer increases rapidly, and mechanical difficulties also arise. Abnormally large pieces and sheets of insulation are required, whilst transport and erection become really troublesome. But the difficulties can be overcome by adopting a cascade connection which enables two or more transformers to build up a high voltage of the required value, three 333,000-volt transformers, for instance, giving a million volts to earth.

These transformers connected in cascade in accordance with the Dessaurer patent are shown in Fig. 1. Each unit has the usual primary winding t_0, t_1, and high-tension windings T_0, T_1, one end of which is earthed or is connected to the tank, whilst the other end is insulated for 333,000 volts. A tapping T_2 is brought out from the insulated end of the high-tension winding, so that the voltage between the leads T_1 and T_2 is equal to the primary pressure. These two leads are brought up through the high-tension terminal, and are connected to the primary winding and to the uninsulated end of the high-tension winding of the second transformer. As these leads are at a potential of 333,000 volts above earth, the whole of No. 2 transformer must be insulated for this voltage by mounting it on porcelain, Bakelite or other insulating supports. The leads T_1–T_2 of transformer No. 2 now have a potential of 666,000 volts to earth, and are connected, in a manner similar to that described above, to the primary winding of No. 3 transformer, which must be insulated for that voltage. The lead T_1 of the third transformer will have a potential of 1,000,000 R.M.S. volts to earth, although the maximum winding insulation of all three transformers is only for 333,000 volts.



FIGS. 1 AND 2—CASCADE-CONNECTED TRANSFORMERS

An alternative arrangement using the cascade connection even more economically is shown in Fig. 2. In this case specially wound transformers are employed with the mid point of the high-tension winding connected to the case, and provided with tappings suitably insulated. For a million-volt set of three transformers each unit would be wound for 333,000 volts, but the maximum pressure affecting the insulation would only be 167,000 volts. All three transformers would have to be insulated from earth, which presents no difficulty, even in the case of the largest units.

Whilst the cascade connection simplifies the insulation and electrostatic design, it may present unusual electro-magnetic problems. The small portion T_1–T_2 of the high-tension winding of the first transformer —shown in Fig. 1—must carry the combined no-load currents, and the rated kilovolt-ampère load currents of the transformers Nos. 2 and 3, and under these conditions the leakage reactance between the relatively small winding T_1–T_2 and the primary winding is so high that compensating windings are necessary to maintain the voltage. Moreover, the no-load kilovolt-ampèrage of a high-voltage testing transformer is greatly affected by the internal capacity of the windings, and this is distributed in such a complicated manner which is difficult to calculate, and must be determined by actual measurement. In order to study the magnitude and importance of these factors and their effect upon the operation of the cascade connection, a number of testing transformers in the course of construction were temporarily provided with the necessary cascade windings for experimental purposes.

Three of these transformers forming part of a 300,000-volt testing equipment for the Western Electric Company were connected as shown in Fig. 1, and the second and third transformers were mounted on temporary insulating supports composed of wood structures and Bakelite paper cylinders. As the space available was limited it was difficult to get sufficient clearance between the transformers. Preliminary tests were carried out to check the high-voltage measurements. At 33,000 volts the pressure was measured by a spark gap, electrostatic voltmeter, and by the voltage ratio of the primary winding, and all the readings agreed within 1 per cent. Higher volteges were measured by the ratio method, and, as spheres of sufficiently large size were not available, by a point spark gap, and it is thought probable that the voltages so arrived at were correct within 2 per cent. A sustained arc between points spaced 9ft. 6in. apart is shown in Fig. 3, the humidity at the time of the test being 69 per cent., the barometric pressure 30in., and the temperature 17 deg. Cent. Under these conditions the flash-over voltage between points spaced D inches apart may be expressed by

$$K V = 20 + 8.7 D.$$

This gives a pressure of 1,012,000 RMS volts to earth for 114in. spacing.

A limiting resistance was connected in series with the spark gap on the earthed side, but when one of the arcs had been maintained for some seconds a flash-over occurred between the foot of the tank of No. 3 transformer and the side of the testing pit, and as there was no limiting resistance in that instance a dazzling white explosive flash was produced, and it is probable, it is thought, that the discharge was due to transient disturbances, for the distance of 90in. indicates a pressure much in excess of 667,000 volts, the normal potential of the tank above earth. Apart from the resistance in the main point gap circuit no high-frequency protective devices were used to damp out transients or high-frequency oscillations. During the tests the discharge broke down the insulation of a 220-volt motor control switch mounted on a pillar behind the high-tension terminal.

A sustained arc with about 970,000 volts across a gap of 109in. is shown in Fig. 4, where the cobweb effect caused by the 50-period alternating current can clearly be seen and where each white line indicates the crest of a wave. The distance between two adjacent lines represents $^1/_{100}$ of a second and for short durations and when the arcs are not superimposed the time of discharge can be calculated from the number of these lines. A dry flash-over at 380,000 volts on an oil-filled power transformer bushing is shown in Fig. 5, which, like all the other illustrations, is from a photograph taken at night with no artificial light except that provided by the arcs. Since the transformers were not intended for the cascade connection under working conditions no attempt was made to control the electrostatic field round the tanks by shielding.

FIG. 3—A SUSTAINED ARC BETWEEN POINTS 114in. APART

The transformers are of a special core type construction, developed for high-voltage testing work. The high and low-tension coils are arranged concentrically, the low-tension coils being single-layer spiral coils extending the whole length of the core leg. The high-tension conductors are covered with manilla paper after the fashion of a paper insulated cable and are wound in the form of cross-over or disc coils, which are mechanically rigid, without depending on the strength of the conductor. Between the high and low-tension windings the insulation consists of oil spaces interleaved with Bakelite cylinders, whilst the remainder of the insulation is chiefly presspahn, specially treated and impregnated. In the arrangement of the insulation between the high-tension winding and frame the main consideration is to control the dielectric field so as to avoid unevenly stressing the material. The method of insulation originally developed and adopted for these high-voltage testing transformers has been applied to ordinary power transformers for capacities of 5 kilovolt-ampères upwards with a distinct increase in economy and reliability.

FIG. 4—A SUSTAINED ARC ACROSS A 10in. GAP

For voltages much above 200,000, the insulation clearances necessary for the high-tension connections and the testing areas necessary make the cost of the building an important item, particularly if a crane has to be provided for handling the transformers. The Ferranti type of testing transformer is designed so that no crane is required for erection or for examination or inspection, for the transformers are mounted

FIG. 5—A 380,000-VOLT ARC

on rollers which run on rails. To remove the transformer the tank end plate is unbolted and the terminals are disconnected, when the transformer can be rolled out without disturbing the high-tension terminal. Before leaving the works the complete transformer is assembled in its tank, which is filled with oil under vacuum. The high-tension terminal is also oil filled and acts as a conservator vessel for the transformer, the oil level rising and falling inside the terminal. An oil-seal calcium chloride breather is also fitted.

To reduce the overall height the transformer is placed on its side in the tank and the high-tension lead and winding insulation forms part of the high-tension terminal arrangement, with the result that the height is still further reduced. It is possible to transport by rail a testing transformer for all pressures up to 350,000 volts, assembled in its case and completely filled with oil, so that no dying out or other attention is needed on the site.

A New Tinning Compound.

WE recently had the opportunity of witnessing some interesting tests made at the National Physical Laboratory, Teddington, with the object of testing the efficacy of a new flux for use in tinning metals, and although the composition of the flux is a secret, the results obtained are sufficiently noteworthy to be put on record.

The flux is a Canadian invention and is supplied by the Soldo Company, of Sicilian House, Southampton-row, London, W.C. 1. It is a white, hygroscopic powder, and is intimately mixed with powdered tin, so that it provides all the materials necessary for the tinning process. The makers claim that any metal, except aluminium, can be tinned with this compound, and that it is unnecessary to clean mechanically the metal to be worked on.

The tests made at Teddington were arranged to confirm these claims, and the micro-photographs, taken from the specimens treated, some of which we reproduce herewith, indicate the physical state of the metals at the tinned surface, while two of them give a comparison between the results of tinning by the ordinary method, and those obtained with the assistance of the new flux. The metals dealt with included phosphor bronze, Ohmal—a nickel, manganese, copper alloy—steel, cast iron and rusty steel.

In each case the metal was heated up by a blow-pipe, and the Soldo was sprinkled on the surface to be tinned, or, alternatively, the ordinary method of dipping in molten tin under zinc-chloride for from 30 to 60 seconds was adopted. The powder evolved fumes, appeared to melt, and rapidly produced a continuous tinned surface when the new flux was used. In the cases of rusty steel and iron specimens, a little rubbing with a soldering iron produced the same result.

It will be observed that in each case the metal chosen is one which it is generally considered difficult to tin, but an inspection of the micro-photographs will show that the tin has actually penetrated the metal and provided a thorough bond. The reason for this abnormal bonding we do not pretend to explain, as we have no knowledge of the composition of the flux.

Coming now to the micro-photographs, it may be as well, specially in the case of Figs. 1 and 2, which are comparative, to quote from the report made by the National Physical Laboratory, which reads as follows :—

> (1) *Phosphor Bronze.*—Strips of phosphor bronze and of "Ohmal"—nickel 3.5, manganese 9.0, copper 87.5 per cent.—were tinned with "Soldo" and joined face to face with a little ordinary solder. Two strips of phosphor bronze were similarly joined together, using tin only, the surfaces being coated by dipping in tin, as described above. Photo-micrographs—Figs. 1 and 2—show sections of the junction obtained between tin and the phosphor bronze at magnifications of 600 diameters [300 diameters as reproduced]. In Fig. 1—tinned by the ordinary method—the upper portion of the field consists of phosphor bronze and the lower portion is the tinned edge. The crystals seen in the photograph are a tin-rich copper-tin alloy, and at the junction can be faintly seen a dark narrow band of another copper-tin alloy. This is more apparent in Fig. 2, which is the corresponding joint made with "Soldo." The black areas in the lower part of the field consist of the lead of the ordinary solder—lead-tin. The half-tone narrow band at the junction is wider than in Fig. 1, and the crystals of tin or tin-rich copper-tin alloy extend to a greater depth. The formation of these alloys indicates that interpenetration has occurred. The photographs are typical of the whole length of the joint. Diffusion was found to be uniform, and no gap was observed between the phosphor-bronze and the tin layer. It was clear that the interpenetration was approximately twice as great in the case of the phosphor bronze tinned with "Soldo" as in that coated by the ordinary method employed.

The test with Ohmal is specially interesting, as joints in that metal, which is largely used in electrical instruments, are usually brazed because soft soldered joints are unreliable, apparently by reason of ineffective tinning. A micro-photograph, having the same magnification of 300 diameters, of the piece of Ohmal tinned, is reproduced in Fig. 3, but it is pointed out in the National Physical Laboratory report that on account of the difference in hardness between the solder and the other metals, it was difficult to polish the specimens without some difference in level, and the lower portion of the field below the joint is out of focus. It is seen, however, that a band of copper-tin alloy—half-tone—has been formed at the joint between the Ohmal and the tin layer, indicating that interpenetration has occurred here also. This test was not compared with Ohmal tinned by the ordinary method.

Several other experiments were made on the tinning of various metals, but those mentioned above are sufficient to indicate the properties of the materials. Two other tests made are, however, noteworthy, and concerned the jointing of two dissimilar metals and the tinning of a very dirty piece of steel. In the first of these two cases, which is illustrated by Fig. 4, a piece of manganese bronze was

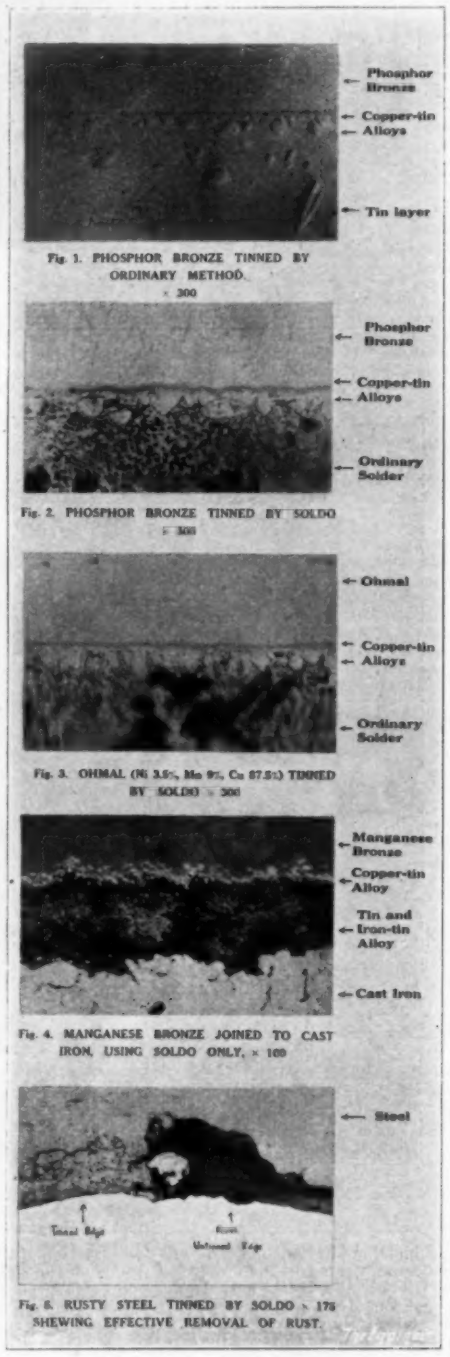


Fig. 1. PHOSPHOR BRONZE TINNED BY ORDINARY METHOD. × 300

Fig. 2. PHOSPHOR BRONZE TINNED BY SOLDO × 300

Fig. 3. OHMAL (Ni 3.5%, Mn 9%, Cu 87.5%) TINNED BY SOLDO × 300

Fig. 4. MANGANESE BRONZE JOINED TO CAST IRON, USING SOLDO ONLY. × 100

Fig. 5. RUSTY STEEL TINNED BY SOLDO × 175 SHEWING EFFECTIVE REMOVAL OF RUST.

EXAMPLES OF TINNING AND SOLDERING

tinned with Soldo, and was joined to a piece of cast iron, tinned by the same process, without any intervening solder. Reporting on this test, the National Physical Laboratory says :—

> The upper portion of the field consists of manganese-bronze, crystals of a copper-tin alloy are seen at the boundary. The dark central portion of the field consists of tin, the black areas being probably the result of interpenetration with the cast iron, which occupies the lower portion of the field.
>
> The piece of very rusty cast iron, which had been exposed to the atmosphere for some years, was successfully tinned with "Soldo," the rust being effectively removed.

One of the most noteworthy tests is, however, that illustrated by Fig. 5, which is a reproduction of a micro-photograph taken at the edge of a piece of rusty steel which was tinned without any previous preparation by Soldo, rubbed in with a soldering iron. The section shows the adjacent rusted and tinned areas respectively at a

GRINDING LATHE FOR RE-TRUEING RAILWAY TIRES

HULSE AND CO., LIMITED, MANCHESTER, ENGINEERS

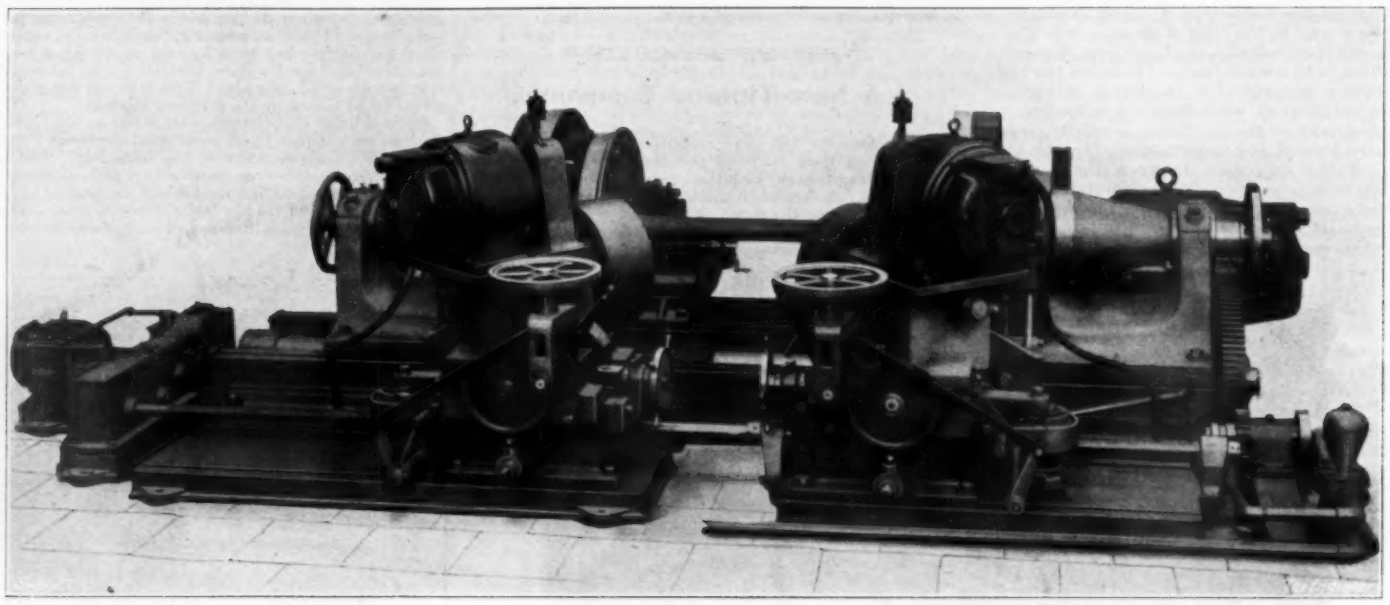


FIG. 1—GRINDING HEAD SIDE OF MACHINE

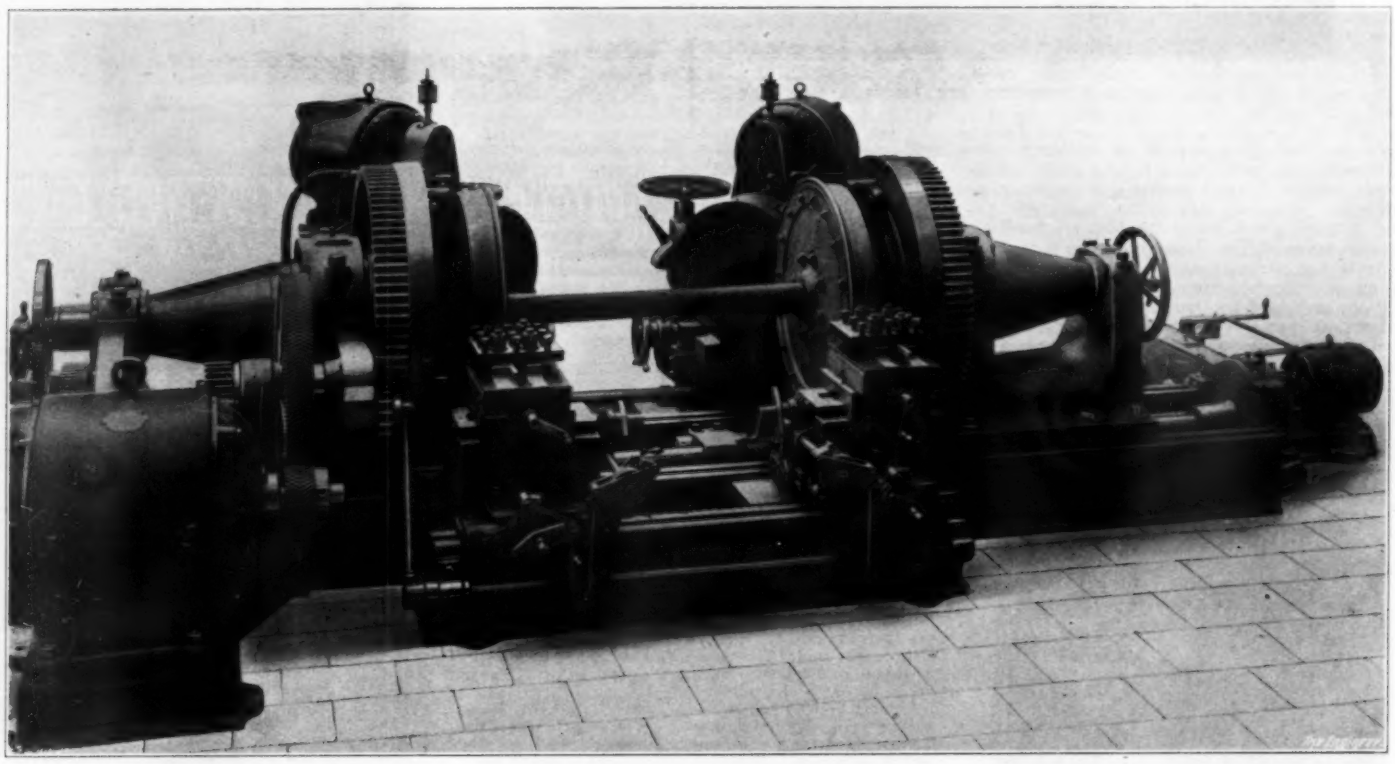


FIG. 2—TOOL REST SIDE OF MACHINE

magnification of 175 diameters. The upper portion of the field shows the steel—the untouched rust is on the right and the tinning is on the left. In the report this specimen is commented on as follows:—"The 'Soldo' is seen to have effectively removed the rust and formed good contact with the steel. This was the case throughout the whole of the section examined where 'Soldo' had been applied."

The value of such a material for a variety of workshop jobs needs no emphasis among engineers; but there is one application which we have found very handy that is worth mentioning. It is the tinning of the ordinary soldering bit. The dirtiest old iron can be taken out of the fire and straightaway tinned by rubbing it in the compound, without even wiping it on a rag. Apart from the saving in time thus effected, there is economy of the bit itself, as there is no need to file it away to get a clean surface for tinning. In another case we successfully tinned some very dirty old gas fittings, which were badly corroded, and found that the tinning went right down to the bottom of the threads, where there was no chance to clean out the dirt.

THE INSTITUTION OF GAS ENGINEERS.

The annual general meeting of the Institution of Gas Engineers will be held in London from June 9th to 12th next. The following provisional programme, which is subject to revision, has been prepared. The meeting is to be held in the Great Hall of the Institution of Civil Engineers, Gt. George-street, Westminster, under the presidency of Mr. J. Ferguson Bell, M. Inst. C.E., general manager and chief engineer to the Derby Gas Light and Coke Company. The morning of Tuesday, June 9th, will be devoted to business and to the delivery of an address by the President. In the afternoon a paper on "The Tankless Gasholder at the Etablissements Arbel, Douai, France," by M. L. Rolland d'Estape, president of the Société Technique de l'Industrie du Gaz en France (hon. member), and a paper on "The Selection, Design and Construction of New Carbonising Plant at Stretford," by Mr. W. M. Carr (member), of Stretford, will be read and discussed. In the evening there is to be a reception and dance at the Connaught Rooms, Great Queen-street, by invitation of the President and Mrs. Bell.

On the Wednesday morning the Birmingham Medal will be presented to Dr. Charles Carpenter, C.B.E., after which the reports of the Wrought Iron Tubing Committee, the Joint Refractory Materials Research Committee, the International Commission on Illumination, and the Institution Gas Research Fellowship, will be received. In the afternoon a paper on "Developments in Gas Calorimetry", by Professor C. V. Boys, F.R.S. (one of the Metropolitan Gas Referees) will be read and discussed.

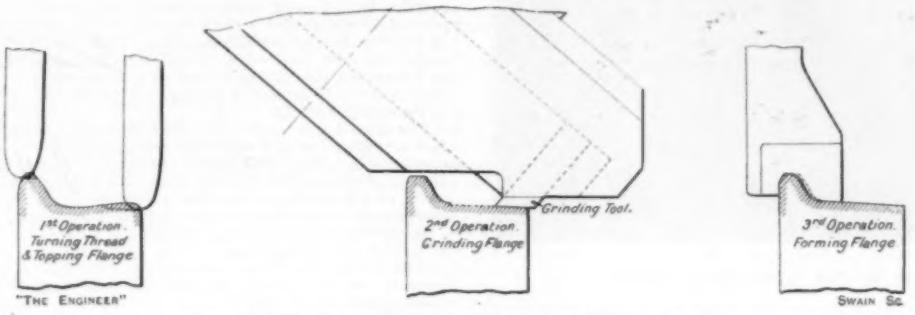
On the Thursday morning papers on "Town's Gas for Motive Power," by Sir Dugald Clerk, K.B.E., F.R.S. (past president); "The Economics of Gas Production on the Thermal Basis," by George Evetts, M. Inst. C.E. (member), will be read and discussed, and the final business of the meeting done. In the afternoon there are to be alternative visits to:—(A) National Physical Laboratory, Teddington; (B) Fulham Works of the Gas Light and Coke Company, to view plant under course of reconstruction; and (C) the Chemical and Physical Laboratories and Burner Department of the South Metropolitan Gas Company, 709, Old Kent-road. On Friday, June 12th, there will be a visit to Derby by special train.

Machine for Re-Trueing Railway Carriage Wheel Tires.

A new development in the machining of worn railway carriage tires is exemplified by the grinding wheel lathe illustrated in the accompanying engravings. There is a tendency to treat the turning of different classes of wheels as though the conditions were similar, and, in consequence, wheel lathes for carriage stocks have generally increased in power and weight in the same ratio as locomotive wheel lathes. The respective conditions of locomotive and carriage wheels when brought in for re-trueing are essentially different. With locomotive wheels deep cuts are often necessary, either to re-form the flange or to bring the wheel diameter to that of others coupled to it. On the other hand, carriage wheels have, generally, but little flange deformation caused by wear, but often the circumferences of the treads have flats and hard spots or segs caused by skidding. These hard places cannot be turned through, and the common practice is to take a cut deep

enough to get well under them, which means the removal of more than the amount necessary to re-form the flange, so that there is a considerable wastage of tire steel. Records have recently been taken in a British railway shop using a softer steel than is current practice. Out of 186 pairs of wheels a second cut approximately ¼in. deep was necessary in 43 cases to get under these hard places. This ¼in. represents about one-tenth of the working life of the tire, and, of course, one-tenth of its value, and the percentage of cases in which extra metal has to be removed because of hard places is higher, the higher the tensile strength of the steel used.

To obviate this wastage of material, the grinding wheel lathe illustrated has been built by Hulse and Co., Ltd., Manchester. It consists essentially of two headstocks, each with the necessary driving equipment, two tool rests and two self-contained grinding heads. The distinctive feature of the design of the grinding head, which is patented, is the angle at which the grinding spindles are set—see Fig. 6—which makes it possible for a large grinding wheel built up of carborundum segments to operate on the tread of a wheel fixed close up to the face plate without fouling the flange. This arrangement allows the axle journals to be gripped by conical segments within the spindle of the headstock, reduces vibration to a minimum, and, by its rigidity, enables heavy cuts to be taken. The



FIGS. 3, 4 AND 5—TURNING AND GRINDING OPERATIONS ON TIRE

grinding wheels are arranged to be traversed across the tread, and a self-acting feed motion is provided.

Each rest is fitted with a gauging device and four tools, one for the tread, another for topping the flange, a forming tool for the flange, and a tool for the chamfer. These tools are set to determined positions by a gauge. By means of the gauging device, the operator can find the lowest point of wear on each wheel, *i.e.*, the maximum diameter up to which it is possible to clean both wheels. A cut is started on the treads and on the flange simultaneously, and, because the indexed rule on the tool slide and the tool are set to the gauge, it is ensured that both wheels are made similar in diameter. The tread on the outside is slightly humped up for about 1in.—as shown in the sketch, Fig. 3—partly owing to rolling of the metal by wear, and it is possible to turn off this projection before encountering the hard places, and when they are reached,

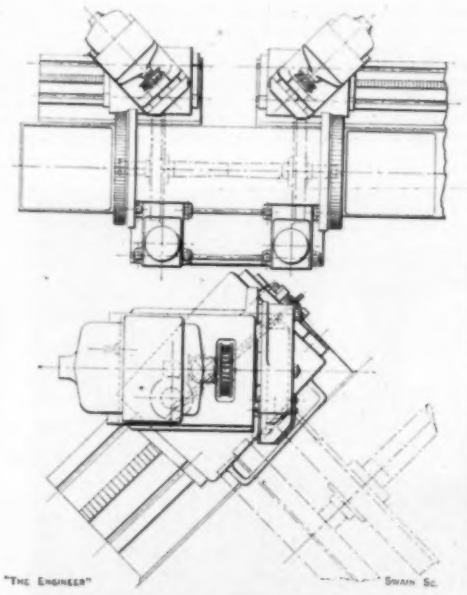


FIG. 6—PLAN OF GRINDING HEADS

the turning is stopped. This turning, may, of course, be omitted, but generally it is the more economical method. The remainder of the tread is ground—as shown in Fig. 4—and by this method the operator can just clean up the wheels, leaving a "witness" of the previous outline. After the grinding is completed on the tread, the flange is finished with the former tool—Fig. 5.

As we have stated, the advantage of this system is that the amount of metal removed is reduced to a minimum, and it is possible to insist on a "witness" of the old form being left somewhere on the surface. As to the actual saving effected by this method, the records referred to above show that in approximately 25 per cent. of the tires machined, one-tenth of the total life and value of the tire is saved at each machining.

Another important feature is the saving in tool steel, the cost of which in breakage and re-grinding when dealing in hard tires is considerable. The time in dealing with a hard tire in the new lathe is less than in the ordinary lathe. Wagon wheels have not these hard spots which are brought about by skidding, and are usually of a lower tensile steel. With the exception of brake van stock, therefore, grinding does not offer advantages. These machines are capable of a high output when turning wheels only, whether they be carriage wheels without hard spots or wagon wheels. They are in successful operation in two shops of two of the English railway groups.

The Primary Causes of the Present State of Industry and Trade.*

The primary causes of the depression in trade are as follows and, as they are common to all our exporting trades, the engineering industry cannot be considered independently under this heading :—

Under consumption of many of the markets of the world, in relation to the full capacity output of the manufacturing countries, due to the inadequacy of their active purchasing power.

The relative dearness of our manufactures due to the high costs of their production and distribution, and our consequent failure to secure a large enough share of the export trade to satisfy our minimum economic requirements.

Our relatively high costs of production and distribution are, in the main, due to the following causes :—

(*a*) The attempt of our people to live on a higher economic plane than is justified by their annual output of new values ; in other words, individual and national extravagance.

(*b*) The hours of working determined, not by the economic needs of the situation, but by the bargaining powers of the trade unions.

(*c*) The remuneration of labour not determined by the economic needs and possibilities of the situation, but by the power of the trade unions to enforce the payment of wages at rates unbalanced by a commensurate output of values, having regard to the foreign competition to be met and the purchasing power of the customer.

(*d*) The arbitrary and frequent mal-adjustment of wages rates in obedience to the demands of strongly organised trade unions, under threat of strikes, whereby wages rates are fixed, not in fair and equitable proportion to the skill and effort required by the worker, but in some rough proportion to the inconvenience and loss that would be inflicted upon the public by the withdrawal of the particular class of labour in question.

(*e*) In addition to its direct evil economic consequences, as reflected in cost of production and cost of living, this has had the effect of producing a grossly inequitable distribution of wages, more especially as between skilled and unskilled labour, and thereby further fomenting industrial unrest.

(*f*) Restriction of output, which, on the part of labour, is due largely though not entirely to fear of unemployment, and on the part of employers to financial limitations and the extreme uncertainty of factors beyond their control whereby what, in more stable times, would be legitimate enterprise, becomes a hazardous gamble.

(*g*) A burden of national and local taxation too great to be borne, without serious loss of vitality, by our industry and commerce.

(*h*) Too many non-producers taking too large a share of the consumers' payments for the products of industry, by increasing selling prices out of fair proportion to any increment of value contributed by their efforts.

The undermining of confidence by the perpetual state of industrial unrest and the direct and indirect monetary losses due to the frequency of actual disputes often involving cessation of work.

The throttling effect on our export trade of certain customs tariffs in foreign countries and in countries within the British Empire.

The restriction of our export trade with countries whose sterling exchanges are seriously depreciated, which evil has been intensified by the recent appreciation of the £ sterling, and our home market at the same time made more vulnerable.

The fact that in some countries with depreciated currencies the internal value of the currency, expressed in commodities and services, is substantially higher than its correspondingly external value, whereby they are enabled to export certain manufactures at prices with which we cannot compete.

Unfair foreign competition in our home market, which is one of the causes, not only of unemployment, but of our high cost of production, because it helps to rob our factories of the volume of work required to employ continuously a large enough proportion of their productive capacity to enable them to function economically.

Our failure to recognise that if our own people, while in the enjoyment of a relatively high purchasing power, are unwilling to support the home industries, which maintain them, by paying the high prices for which they themselves are mainly responsible, it cannot be expected that overseas purchasers, mostly less fortunately situated, will be either willing or able to pay them.

The application to unproductive purposes of too large a proportion of our financial resources, having regard to our heavy load of debt and the needs of our wealth productive industries on which the national solvency finally depends.

It will be seen that the causes referred to above are beyond our direct control, though the British Government, by taking appropriate action, may be able to influence in varying degrees their future trend and magnitude.

From the immediately practical point of view, we would, therefore, suggest that attention should be directed chiefly to the causes within our own control.

The most exhaustive study of the external causes would not provide us with solutions of our home problems, but would merely supply an unneeded confirmation of the known necessity of substantially reducing our costs of production and distribution with the least possible delay.

The Future Prospects of the Engineering Industry.

These will, of course, depend partly on political, industrial and financial developments abroad, and partly on the action taken at home to remove or counteract the causes of depression within our own control.

At the best, this country can influence, only to a very limited extent, the course of events abroad, especially outside the British Empire.

The remedies urgently needed at home are indicated by the above-mentioned causes of the disease. Unless they are applied and given a fair chance to be effective, our only hope will lie in the possibility of our foreign competitors sinking to our level of productive efficiency, as expressed in our high selling prices and low profits.

Our share of the world trade in manufactured articles will inevitably depend on the relative efficiencies of ourselves and our competitors in manufacture and trade. At present the balance is against us, and to redress it, either our efficiency must rise or theirs must fall.

A little encouragement may, however, be extracted from the fact that, to some extent, the margin of competitive power against us at the present time is due to abnormal conditions of a transitory nature. For example, Germany's costs of production are now rising, and it may be assumed that they are still below the level at which they may be expected to become stabilised.

Nevertheless it would be lunacy to drift along on our present course in the belief and expectation that we will be saved from disaster by political and economic follies of our rivals causing their selling prices to rise to the same level as our own.

If the gold prices of engineering and other manufactures were artifically forced up, until they bore no economically warrantable relationship to the prices of food and raw materials, the demand for them would necessarily fall in order to maintain the balance between active demand and available purchasing power.

The bulk of the annual wealth production of the world is the produce of agricultural and allied industries and mineral mining. The average real wages of the workers engaged in them are, and must remain, far below those engaged in the manufacturing industries of Europe and America. The vast majority of the workers are of races having a much lower standard of living than our own. But, it is their purchasing power in the aggregate which directly or indirectly determines the volume of manufactures that can be absorbed, and as a whole the prices of manufactured articles cannot rise appreciably without reducing the demand for them.

It would, therefore, appear that we should not build any high hopes on the international spread of the disease of inefficiency and its consequent high costs of production.

In the light of these facts, it is impossible to escape the conclusion that our only hope lies in reduced costs of production and distribution, but its fulfilment is dependent on the willing co-operation of capital, administration and labour.

It is true that some things lying outside the labour question might be done to improve the state of the engineering industry. We refer to such matters as invention, research, standardisation, simplification, trade propaganda, publicity and salesmanship. But they all involve more or less speculative expenditure requiring confidence and the ability to take financial risks. Unhappily, confidence has been badly shaken and the spirit of enterprise consequently subdued.

We share the opinion of those who believe that a truce in industry is the first essential to the recovery of our trade. The mere calling of a truce, however, would be of little value unless it were used to negotiate the terms and conditions of a prolonged peace.

Everything points to our having reached a stage in the evolution of industry when some readjustments are necessary to check retrogression and enable progress to be resumed.

Unless these things we have indicated can be done, and done quickly, we fear that the future prospects of the engineering industry in this country will give cause for the gravest concern.

* From a Report, issued by the British Engineers' Association, entitled "The Present Condition and Future Prospects of the Engineering Industry." Price 7s. 6d.

The United States Shipping Board has selected thirteen of its steamers in which Diesel engines will be installed. This is part of its programme for the conversion of eighteen steamships to motor ships, involving the expenditure of 25,000,000 dollars. Tenders for placing the engines in the hulls will be invited about July 1st, and contracts will be awarded at intervals as the companies are prepared to deliver the Diesel motors ordered recently. Details of the ships on the first list are as follows :—West Harts and West Hartland, 8600 tons each, now lying at San Francisco and Seattle respectively ; Crown City, West Honaker and West Cusseta, 8300 tons each, the first at New York and the last two in the James River. Eight ships, of 9500 tons each, as follows :—Yamachichi, in James River ; Wilcox, at Mobile ; Tampa, in James River ; Seminole, at New York ; Unicoi, Sawokia, City of Bayville and City of Dalhart, all in the James River.

The Centrifugal Casting of Large Diameter Pipes.

The production of cylindrical castings, ranging from small diameter short length cylinders, up to 12ft. long spigot and socket water pipes, by the process of spinning the molten metal in rapidly rotating dies, or moulds, has come to be known as the centrifugal casting process, and

FIG. 1—36in. SPIGOT AND SOCKET PIPE CAST ON THE HURST-BALL SYSTEM

is now familiar to most engineers in this country. A recent development of the Hurst-Ball centrifugal casting system, which has been operated by Centrifugal Casting, Ld., Kilmarnock, during the past four years on the production of castings for piston ring drums and cylinder liners is of particular interest, as it deals with the application of the system to the production of large diameter spigot and socket pipes. The engraving, Fig. 1, shows a 36in. diameter spigot and socket pipe just affer being cast by this process, and that size of pipe is, so far as we are aware, the largest yet produced by any process of centrifugal casting.

The special feature claimed for this system of casting is the production of sound castings, which are directly grey and machinable, without the necessity of annealing, and that feature is protected by a series of patents. The pipes produced by the Centrifugal Casting Company's machine are described as being of a direct soft grey cast iron, which is identical with that obtained in the very numerous smaller castings which have been commercially produced by this company for piston ring drums and similar purposes which have guaranteed minimum machining speed of 60ft. per minute.

The presence or absence of the hard white chilled iron structure in cast iron is due to the suppression of the characteristic phenomena of cast iron—the formation of graphite. It is now well known to most metallurgists that the formation of graphite in cast iron takes place after the final solidification of the iron at a temperature of as low as 50 deg. below this final solidification point. The extent of the graphite formation in a cast iron of any given composition depends upon the rate of cooling through those ranges of temperature in which the graphite commences to form. The rates of cooling at temperatures previous and subsequent to the temperatures of the commencement of graphitisation are of practically no importance in determining the presence of graphite in the chilled structure. On the one side of quick rate of cooling cast iron is undoubtedly very sensitive to the effect of small changes in the rate of cooling from the point of view of the formation of graphite, and there is undoubtedly a critical rate of cooling, above or below which graphite is or is not produced in a cast iron of any given composition.

Experiment has demonstrated in simple cylindrical castings of similar radial thicknesses, that metal dies can be designed of such dimensions that the mean temperature attained by the die, or the surface temperature of the die and the temperature gradient across the radial thickness of the die can be maintained within appropriate limits when operating on the continuous production of such castings at economical rates of output. The limits of temperature gradient and surface temperatures of these dies have been determined by practical experiment for the conditions of maintaining rates of cooling in the castings sufficient to prevent chill, and at the same time to obviate the attainment of unduly steep temperature gradients across the dies under which the dies are caused to deteriorate rapidly, and pinhole defects are produced in the castings. These conditions have been determined for both water-cooled and atmospherically cooled dies. The die designed for the production of the 36in. cast pipe was arranged for normal atmospheric cooling.

From the early days of centrifugal casting it has been recognised that, for the production of long castings of even thickness, the introduction of the molten metal must be effectively controlled. It is apparent from the early patents—and experiment confirms the fact—that the introduction of molten metal in a long flat continuous stream of approximately the same length as the casting is difficult to control from the point of view of the ultimate even thickness of the pipe. This difficulty is largely due to the rapid rate at which the metal solidifies. If the molten metal remained liquid for a considerable time, the distribution of the pressure due to the centrifugal action throughout the liquid metal would ultimately result in the metal taking up a position in which all the forces were in equilibrium, and a casting with a parallel bore and of even thickness would result. In practice, however, the molten metal solidifies so rapidly, that in long castings there is rarely time for sufficient longitudinal movement of the metal in the liquid state to smooth out any irregularities in the distribution of the metal on the surface of the die.

These conditions have been met in various ingenious ways by different inventors. To quote two cases as illustrating this—Joseph Whitley in 1884, patent No. 13,204, when dealing with castings 9ft. in length, utilised a trough-like pourer of the type indicated in Fig. 2. This trough was equipped with a series of nozzles or ingates spaced at even distances—in this particular case 6in. apart. A reciprocating motion of an amplitude of 3in. was given to the trough whilst tilting, the effect of which was to introduce the molten metal on to the rotating mould surface in a series of continuous streams of narrow width. The continued reciprocating motion of these streams applied to the rotating die, distributed the metal in a number of spirally-related subdivisions, according to the number of nozzles or ingates in the trough. Each subdivision consisted of a series of interlacing spirals, the slight longitudinal movement of which was intended to bring about an even distribution of the molten metal.

In another interesting device, which was adopted by Lane, 1891, the molten metal was introduced into the die in the form of a continuous stream of narrow width. A rotary movement was applied to the stream and, at the same time, the mould was continuously withdrawn over the rotating spout. The effect of this relative longitudinal movement between the mould and pourer spout is such that the stream of molten metal is continuously deposited over the whole of the surface of the rotating mould. The now well-known Lavaud system is of a somewhat similar nature, but in its case the molten metal is admitted into the rotating die down a stationary pouring channel equipped with a specially shaped nozzle or lip outlet.

The Hurst-Ball type of pourer secures a somewhat similar result in an entirely different manner. This pourer arrangement is a development of the tilting trough type of pourer which has been used in many cases. This pourer was equipped with a horizontal weir edge of approximately the length of the casting to be produced, and it was arranged to be tilted by partially rotating about its axis in such a manner that the metal was deposited on the surface of the rotating die in a continuous sheet of approximately equivalent length to that of the casting being produced. The original idea in the development of the Hurst-Ball pourer was to form their weir edge in a series of steps varying in height along the length of the trough as shown in Fig. 3. On partial rotation of this tilting trough the molten metal first flows over the lowest edge and successively over the edges of higher levels as the rotation is continued, until the whole of the metal is deposited over the surface of the die in a continuous series of annular rings of a width depending upon the length of each "step-like" weir edge. By allowing the molten metal to flow down this tilting trough at a constant rate, the molten metal is deposited evenly over the whole surface of the rotating mould.

The reduction in length of the step-like weir edges results in the production of a weir edge which is more or less a portion of a helix. And that is the form now employed. It is illustrated in Fig. 4, which shows the pourer arrangement and a portion of the mould of the experimental machine on which the large pipe—see Fig. 1—was cast.

It will be understood that the partial rotation or the tilting of this trough through the complete angle subtended at the axis of the pourer by the difference in level between the two ends of the weir edge will result in the continuous deposition of the molten metal in a complete series of annular rings of narrow width, depending upon the velocity of the molten metal supplied. It is claimed that, by supplying the molten metal in constant quantity per unit time to the tilting trough, the production of a casting of even thickness and parallel bore is thus assured.

These are the two principal features of the Hurst-Ball system, which has now been in effective operation over a period of four years on the production of many forms of centrifugal castings, such as piston ring drums, cylinder liners, rolls, and the like, and has now been adapted to pipes.

The makers point out that the principles involved in the Hurst-Ball system, as above described, enable the casting machines to be of simple design from a mechanical point of view. The entire absence of any relative longitudinal movement between the rotating mould and pourer arrangement eliminates the necessity of carrying such large moulds in rigid and complicated bearing arrangements and considerably simplifies the whole of the controlling mechanism. The general design and lay-out of the machine lends itself to the adoption of comparatively simple and easy methods of extracting and handling such large castings. The production of castings free from hard chilled surfaces with the consequent elimination of the necessity for annealing, is of special importance in the case of large diameter pipes, which would obviously involve large and expensive annealing plant.

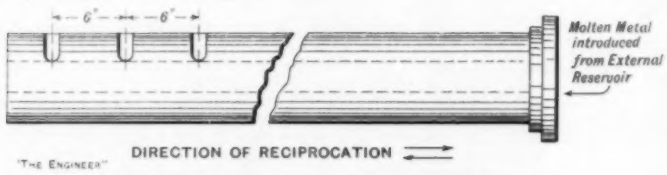


FIG. 2—DIAGRAM OF JOSEPH WHITLEY POURER

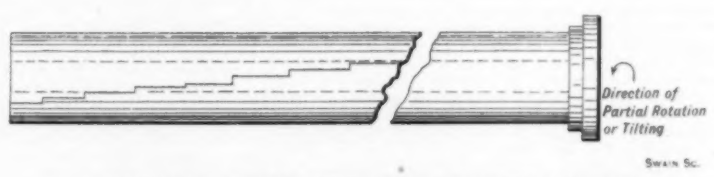


FIG. 3—ORIGINAL STEPPED-WEIR EDGED HURST-BALL POURER

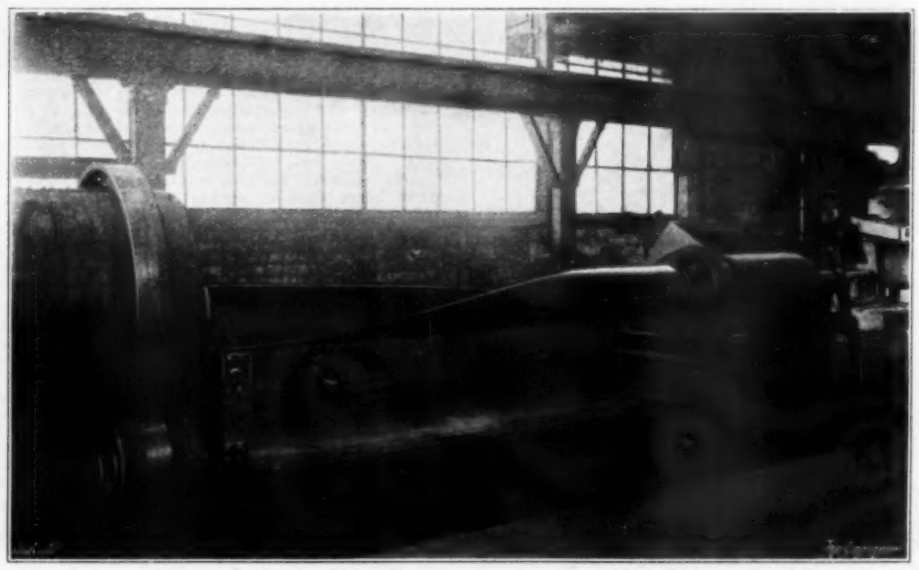


FIG. 4—HELICAL POURING TROUGH OF HURST-BALL PIPE CASTING MACHINE.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(*From our own Correspondent.*)

Easter Holidays.

THE Easter holidays will cause little interruption to business in the Midland iron and steel industries, and little concern to either producer or consumer. True, many of the works have closed down for a spell, but buying of material had practically ceased a week ago, consumers having sufficient material to fulfil their immediate moderate engagements. They are under no necessity to hold large stocks for the resumption of operations, for there are only a few orders on most of their books, and ample iron and steel can be obtained without delay if required from the fairly substantial stocks at makers' works. The quarterly meeting of the Midland iron trade, held last week in Birmingham—a week earlier than usual, owing to the holidays—was only moderately attended, and proved a very tame and unsatisfactory gathering. The alteration of the date may possibly have affected the attendance and been responsible for the absence of many representatives of the trade almost invariably present on these occasions. However, a few were present from most of the iron and steel centres. The general desire on 'Change appeared to be to ascertain precisely the trade pulse, which for some time past has been beating irregularly. Comparatively few orders were booked, and transactions were small individually. Iron was in no better demand, though in some quarters the depression is not considered to be quite so acute as it has been recently. It is held that this market stagnation cannot possibly continue, as such consumers as engineers and founders are known to be approaching the end of their stocks. The lifelessness of the market, however, clearly showed the discouraging conditions which exist in the works. The heavy engineering branches are still operating very irregularly, and steel masters are in many cases very badly off for business sufficient to keep present active plant in operation. Users of steel and iron continue to press for lower prices when placing small orders, and they are gradually forcing down values by refusing to make contracts of any magnitude, satisfying consumptive needs from week to week.

For the Good of Industry.

The efforts being made to secure the good of industry generally are being closely followed by industrialists in the Midlands. It is considered extremely satisfactory that the call to masters and men to get together is finding a response in so many quarters. Already discussions between employers and employed are in progress in the mining, shipbuilding, engineering, railway and cotton industries, and the tackling of the problem of restoring trade industry by industry must prove all to the good.

Midland Canal Facilities.

Deep regret was expressed at a meeting in Birmingham last week of the Executive Committee of the National Council of Inland Waterways that consideration by the Ministry of Transport of various proposals submitted from time to time has been unduly prolonged, and the Council decided again to call the attention of the Government to the vital necessity of dealing with the canal and inland waterway problem on a constructive and practical basis. After discussion, the Council decided that to meet the immediate needs of Midland transport, it was desirable that an investigation should be made of the need of improved facilities on the various canals which serve Birmingham and the Black Country. Whilst offering no comment at the moment on the larger schemes contemplated in relation to the enlargement of the Birmingham and Worcester Canal and the Birmingham–Severn scheme, the Council feels that an immense amount of useful reconditioning work could be carried out at a comparatively nominal cost on the existing canals. It was therefore decided to invite the Ministry of Transport to appoint a competent officer to make an inspection of the three main lines of water communication to Birmingham, viz., London to Birmingham, Worcester to Birmingham, and Mersey to Birmingham, with the object of ascertaining what immediate repairs and improvements are essential in order to facilitate the conveyance of a larger volume of traffic than is now possible with the existing type of barge, and without extending the present limits of barge accommodation.

Steel.

In the steel trade of the Midlands very little new business is being given out. Prices remain irregular, competition being exceptionally keen for the relatively small amount of business that is available. Orders for constructive work practically cover the whole of the new contracts, and this department is fairly well maintained. Midland engineers have booked fair orders for bridges and building extensions, and they are now in a much better position than for some time past. In the various branches of the steel market the struggle for orders is as keen as ever, but it is less complicated in some directions by competition from France, Belgium and Germany. To consumers who defer buying till they want the material, the unreliability of deliveries from the Continent is a serious offset to lower prices. An increasing number of home steel masters have abandoned the £8 15s. quotation for angles and joists. They quote £9, which, they say, is necessary to cover production costs. Merchants have been asking this figure for small lots for some time. Small steel bars are readily obtainable at £8 15s. Billets and sheet bars are offered at £7, continental competitors quoting £6 5s. One big South Wales organisation was stated at the quarterly meeting last week to be offering billets at £6 15s. The official price for English wire rods is now £10 10s. No. 5 rods rolled from continental billets can be obtained at £9 5s. There is at the moment a good demand for cold rolled bright steel, one firm having added case-hardening steel to its products, chiefly to meet requirements of the motor industry. A few sales of steel scrap have been made, but few buyers are ready to accept delivery, which adds to the difficulties of the merchants.

Raw Iron.

Pig iron prices are generally steady, but some reliance is placed on the possibility of reduction, owing to the weakness of furnace coke, which is a shilling cheaper than three months ago, on the basis of 15s. 9d. This fuel is rather plentiful, and may possibly further recede. As to pig iron, the present limited inquiry is restricted almost entirely to foundry grades, and quotations are much the same as last week. The restricted scale on which buyers are operating has put some furnacemen in a quandary, and prices have not been adhered to in all cases. The forges are as badly off for employment as ever, and expectations of a revival at the foundries do not materialise. The standard for Northamptonshire No. 3 continues at £3 12s. 6d. and for Derbyshire £3 17s. 6d. Northamptonshire forge is quoted £3 8s. to £3 9s., and Derbyshire £3 12s. 6d., but business in this branch is insufficient to test the market and consumers have little doubt as to their ability to get these figures shaded. Stocks of pig iron in this district are not large, but consumers consider that buying may quite safely be postponed until the need becomes more urgent. It is quite easy to get quick delivery of any consignment. Cold blast iron continues at £10 5s., the figures adopted six months ago. With the slackness in the heavy ironfounding trade, the demand for this material is not large.

Finished Iron.

Demand for Staffordshire finished iron unfortunately continues to fall off, and makers of marked bars are now complaining of an insufficiency of orders. The few works rolling this high-class material are operating about four days a week. It is understood that bar makers have been in conference, and, after reviewing the situation, have come to the conclusion that nothing can be done by price manipulation to stimulate demand. The consumption of wrought iron is at a low ebb, and even in the case of makers of best bars the horizon is very limited. There is only the slowest demand for Crown quality bars, and the £12 15s. figure is often shaded. The call for cable and chain material is negligible, owing to the inactive state of the shipyards. Business in nut and bolt iron is practically suspended, the trade being monopolised by continental competitors. The disparity between native and foreign prices is too great to be bridged by any readjustment which Staffordshire mills could possibly effect. The basing of selling rates on production costs is felt to be the only policy open to them. The reduction of 2½ per cent. in ironworkers' wages to which I referred in the "Latest News" column last week, is the first reduction for over twelve months, wages during the past year having steadily advanced.

Sheet Values.

Galvanised sheets have more than maintained the stronger position asserted a week ago. Values of 24 gauge corrugateds have risen to fully £16 10s. Many mills are quoting higher. There is a fair amount of business passing. Black sheets are in strong demand, and prices are firm.

Tinned and Lead-coated Sheets.

The Tinned Sheet Manufacturers' Association has re-declared last quarters' prices, viz., best charcoal, £58; charcoal, £56; unassorted, £52 per ton to 20 gauge. There is only a restricted demand for tin-plate wasters at the basis rates. The price of lead-coated sheets has been reaffirmed at £28 per ton to 20 gauge.

Great Wyrley Colliery Closing Down.

The Great Wyrley Colliery Company, of Cannock Chase, has decided, owing to the present state of trade and the immediate future prospects, to close down. On Saturday last week all the company's employees, numbering about 700, received fourteen days' notice. The colliery was opened in 1874, and for many years had a remarkably successful career. In recent years, however, the undertaking has had some difficult times, consequent on the working of the lower-grade seams of coal.

Unemployment.

The unemployment returns for the Midlands area, after having had a most successful downward run, has this week taken to the up grade, the figures showing an increase of 697. The total of 130,539, compares with 129,842 for the previous week. Birmingham and Coventry both show reductions, the former of 716 and the latter 75, but an increase of nearly 1000 at Nottingham did not require the slight increases at Bilston, Leicester, Redditch, Smethwick and Stoke-on-Trent, to weight the scales against improvement of the position.

LANCASHIRE.

(*From our own Correspondents.*)

MANCHESTER.

General Outlook.

THE markets here for the iron, steel and the non-ferrous metals are all about as depressed as they can be. Of course, it was not expected that any business of importance could be done this week, as even if there were any activity people would no doubt postpone buying now until after the holidays; but it is not only the absence of business which is depressing, but the absence of hope for future business. The further collapse of the French Exchange is no doubt a matter of serious moment, and may lead to lower prices—temporarily—for French iron and steel material; but the underlying cause of all our industrial troubles is the fact that Great Britain can no longer produce cheap iron, steel and fuel. Her prosperity was based on this cheapness, and we must now look for some other basis if prosperity is to return to us.

Metals.

The collapse in copper prices seems to have shaken confidence in the metal markets to its foundations. Standard copper was said to be on a "rock bottom" when the price was £5 per ton higher than it is now; and people argue that if the market can go down £5 below "rock bottom" there is clearly a possibility of further losses. There were pessimists in Manchester who said that they did not see why standard should not go to £50 per ton unless the output is sternly dealt with and brought into safe relation with the present rate of consumption. This suggestion looks absurd, but, of course, it is true that many of the American producers of copper can make it at much lower levels. On the other hand, there are makers who cannot work at a profit with prices as they are at present. The whole position is very obscure; and yet one cannot help feeling that a re-action from the present low prices is highly probable. In the Manchester market very little buying is being done by the consumer; but so far as the engineering trade is concerned, there seems to be some fear of a stoppage, and, of course, in such circumstances, it will be the object of prudent firms to have as little stock as possible in hand when the stoppage does occur. The prices for manufactured copper and brass have been reduced in accordance with the fall in raw material. Dealers in scrap metals here are very depressed, and offer only very low prices when buying. Engineers who can use the scrap metals, especially scrap gun-metal, ought now to be able to buy very cheaply from dealers, who are paying low prices, and are anxious to keep down stocks. The tin market has been very jumpy, and it is impossible to form any views upon it. A market is outside any reasonable view when, upon the announcement that the stocks are reduced, it immediately drops instead of advancing. Tin has been subject to unreasoning sentiment for a long time, and no one can say what is going to happen. Lead and spelter are both rather dull markets, but the movements in them are not very decided yet. Experts here do not seem to think that the great slump in lead prices is yet close at hand.

Pig Iron.

The demand for foundry iron is, of course, very much restricted this week in view of the Easter holidays. As there is no apprehension amongst consumers of any probable increase in the price, but rather an expectation of easier terms when the holiday is over, one cannot expect any forward buying, and the small demand for prompt use is almost suspended this week. So far as sellers are concerned, there is no disposition to quote lower prices at present; but, of course, this would be useless, as it would only encourage buyers to look for cheaper iron when they are again prepared to buy. Hence Derbyshire No. 3 is said to be steady at 85s. to 85s. 6d. per ton delivered in this neighbourhood. Cleveland iron has been rather easier again, but perhaps merely because of the holiday feeling. Sellers there are however, not offering at less than 77s. 6d. on trucks, and as this is the furnace price for Derbyshire there is no possibility of bringing Cleveland into South Lancashire. Northamptonshire foundry iron is at 72s. 6d. in trucks at the furnaces, and it is said that forge iron can be bought there at 68s., or perhaps 67s. 6d. This would mean about 80s. for Northamptonshire forge delivered free to the Lancashire ironworks, but there is practically no demand for it. Derbyshire forge is dearer, and, in fact, seems to find a better market elsewhere. However, the Lancashire ironworks have so little demand for their bar iron that they use very little forge pig; and, of course, heavy wrought scrap at 80s. to 82s. 6d. is a much cheaper material.

Steel.

The reduction in the North-Eastern price for steel plates for the shipbuilding industry is not yet admitted as applying to steel plates for other purposes in the Midland district, hence merchants here still quote £9 15s. delivered; but one does not see how this price can be maintained when business is resumed after the holidays. In the end the concession to the shipbuilders will have to be extended to other consumers. For steel joists and angles the nominal price here is £8 15s. per ton; but in this case also the concession to the shipbuilding trade must be felt eventually. One would be inclined to foretell that joists and angles will be available here at £8 7s. 6d. in a week or two.

Scrap.

There is no demand for scrap this week. The Sheffield buyers of melting steel scrap are holding off, and dealers in Lancashire seem afraid to pay more than 60s. per ton for it on trucks. Even at this price it could not be sold to South Wales at a profit, or even without loss. Foundry scrap is neglected, but the nominal prices remain at from 80s. to 85s., according to quality, with rumours occasionally of lots at 77s. 6d. Heavy wrought scrap is steady at 80s. to 85s. per ton.

Electrical Contract for a Local Firm.

The recommendation of the Electricity Committee of the Salford Corporation to place an order for a 1500-kilowatt rotary converter and switchgear with Metropolitan-Vickers Electric Company, Trafford Park, was approved by the Corporation last week. It came out during the discussion which took place in the Council chamber that there was a remarkable agreement in the prices tendered by the British firms for the contract. These firms offered delivery in five months, whereas a Swiss firm which tendered required 9½ months to complete the contract, although the price quoted was about £1000 less than the accepted tender. One of the factors which weighed with the Council in placing the order, besides the time factor, was that over 3000 of the Metropolitan-Vickers workpeople reside in Salford.

Institution of Mechanical Engineers.

At a meeting of the North-Western Branch of the Institution of Mechanical Engineers, held at the College of Technology, Manchester, on Thursday, the 2nd inst.,

Mr. E. A. Eborall gave a very instructive lecture on "Swiss Federal Railway Electrification" to a very large audience. After dealing with the historical side of the subject and describing the water power resources of Switzerland, Mr. Eborall discussed the considerations bearing upon the decision of the Government to adopt the single-phase system. The lecturer described the several large power stations, the method of distribution of the power, the sub-stations and typical electric locomotives. The interest in the lecture was considerably enhanced by the use of the cinematograph, which showed pictures of the country taken from moving trains and a number of views taken in Brown, Boveri's works illustrating the building of the largest locomotives in use, some of which weigh over 140 tons, and are equipped with power plant up to 2400 horse-power. It was stated that the amount of coal which would be required if water power were replaced by steam would be about 500,000 tons per annum, all of which would have to be imported at a cost of not less than 46 shillings per ton. It was stated that the post-war traffic on the Swiss railways had not yet reached that of 1913, which was the best year these railways had experienced.

Barrow-in-Furness.

Hematite.

The hematite pig iron trade remains about the same. There is a lack of life in it, and but for the consumption at Barrow and Moss Bay of a considerable amount of iron by the steel departments, there would have to be a damping down of furnaces. There are thirteen furnaces in blast. Some time ago there was an accident in Cumberland, one of the furnaces collapsing. This furnace has not been replaced by the putting in of another, which is a sign of the state of trade in the district. Customers are ordering mixed Bessemer numbers in small parcels, just sufficient for their immediate needs. The trade overseas is small in the aggregate. A small part cargo went to Treport last week, but there were no dispatches to America. The demand for special qualities of iron is small. Inquiries are not heavy by any means, and at present the outlook is dull.

Iron Ore.

The iron ore trade is a reflection of the iron trade. There is a certain amount of ore going out of the district, but it is not great; in fact, it is less than it was three months ago. A small part cargo went to Treport last week. There is a growing tonnage of Norwegian iron ore coming in from Kirkenes. It is treated before it is shipped and is well spoken of. Arrangements are being pushed on at Kirkenes to permit of quicker loading, and when they have been completed a ship will be able to take in a cargo of about 5000 tons in about twenty-four hours. Spanish ore is in moderate demand.

Steel.

The steel trade is quiet. The continental competition is keenly felt. Barrow is kept going, but will stop for the holidays, and Moss Bay is working week and week about. The foundries are engaged on moderate orders. In the hoop and small section mills at Barrow a better state of things exists, and the mills are kept going fairly regularly.

SHEFFIELD.

(From our own Correspondent.)

Furnaces Short of Work.

There is no improvement in the heavy steel trade locally, and, judging by all the reports to hand, similar conditions exist in the other centres of the country. There have recently been some additions to the number of blast-furnaces damped down, which shows that the steel trade's demand for raw material has suffered a further fall. There has been no more closing of open-hearth furnaces in this district, but the production tends to shrink, and a reduction of melting will be necessary soon unless the situation improves. Prices of iron and steel materials are easier, and there is scarcely any market for heavy steel scrap. At the time of writing, the duration of the Easter holiday has not been decided upon, but there is a probability that it will be longer than usual.

Railway Orders Falling Off.

The railway steel departments are still active, but they are not receiving new orders to an extent sufficient to replace those which are worked off, and the outlook is unsatisfactory. The firm of John Baker and Co., Ltd., of Rotherham, which is largely engaged in the manufacture of railway material, held its annual meeting last week, and the chairman made some significant remarks on the present position. Owing to the decline in the export of coal, he said, not so many wagons were required, and the large orders for the English railway companies were being rapidly completed. The orders for wheels and axles for India and the Dominions were chiefly being taken on the Continent, owing to the price being pounds below the British quotations. He added that conditions for the coming year looked dark in the iron and steel trade, prices having gone down until there was not change for sixpence; indeed, most firms were taking work at a loss. In the company's business prices had dropped tremendously during the last two months, and the demand had decreased.

Cement-making Machinery.

Some good orders of an engineering character have been reported during the past week. They are for cement-making machinery, and have been secured by Edgar Allen and Co., Ltd., Sheffield, in the face of strong foreign competition. One contract is for a complete plant, with electric motor equipment, for the Dunstable Portland Cement Company, Bedfordshire. It is a two-unit thick-slurry plant, with a capacity of 110,000 tons per annum. Included in it are two 200ft. rotary kilns, and patented combination cement grinding mills. A second contract is for a complete plant for the Standard Portland Cement Company, Ltd., of New South Wales, with a capacity of 100,000 tons per annum. This plant is designed to operate on the dry process, and will be electrically driven throughout, with provision for waste heat boilers to utilise the flue gases from the rotary kilns.

Orders on Hand.

Messrs. Allen have also on hand, or nearing completion, three other contracts of a similar character. One is for a complete cement-making plant to operate on the thick-slurry process for the Sulphide Corporation, Ltd., New South Wales. It is designed as a three-unit rotary kiln plant, with a total capacity of 90,000 tons per annum. This order was secured in competition with British and Danish firms. For the Gillingham Portland Cement Company, Ltd., Kent, a complete plant is being made, with a capacity of 60,000 tons per annum, to operate the wet process. One 200ft. rotary kiln is included. At Gillingham there is being installed the latest type of turbo-pulveriser for the pulverising and firing of the coal to the rotary kiln. For the Bwana M'Kubwa Copper Company, Ltd., Northern Rhodesia, four rotary furnace units are being made for the reduction of copper ore. This plant is of particular interest to the mining world, owing to the special process which is to be operated on a large scale by the Bwana M'Kubwa Company.

Depression in Stainless Cutlery.

No matter what other branches of Sheffield trade have been adversely affected during the past four years, the department making table knives of stainless steel has enjoyed an unbroken spell of activity. Since 1920, outputs have continually increased, almost every week, and at the end of last year huge figures were reached. Now, however, a considerable decline is being felt by large and small firms alike, and the industry is depressed for the first time in its experience. There are still some large contracts on hand, however. The carrying on of the Wembley Exhibition will be a good thing for this trade, while the electro-plate department is benefiting from the same cause, and is booking good orders for spoons, forks, cruets, and other tableware. The pen and pocket knife, scissors and ordinary razor sections of the cutlery trade are quiet.

Important Colliery Deal.

A colliery deal of much interest and importance has been reported during the past week, in the transfer of the Hoyland Silkstone Colliery and By-products from the Instone group to Newton, Chambers and Co., Ltd., of Thorncliffe, Chapeltown.

Reclaiming Derbyshire Collieries.

Efforts are being made to give a new lease of life to the Renishaw Park Collieries, formerly owned by J. and G. Wells, Ltd., Eckington, which have been closed for about fifteen years. At present they are flooded, but Horrox and Co., Ltd., of Sheffield, the proprietors of the Furnace Hill Colliery, are taking measures to clear the water away. Powerful electrical pumps have been installed, and already remarkable results have been achieved in the effort to get one of the pits ready for work. In the steps they are taking, Messrs. Horrox have the support of Sir George Sitwell, the owner of the land. There is good hope that it may be possible to wind coal in the near future.

Cortonwood Developments.

The Cortonwood Colliery Company, near Barnsley, has decided to sink to the Silkstone seam, which is 95 yards below the Parkgate. At the annual meeting of the company, the chairman reported that one of the shafts had already been deepened, and that coal had been reached which had proved to be of good quality. The work on the other shaft will be proceeded with and further plant will be purchased for the development of the seam. At the Nerquis Colliery, said the chairman, work had been somewhat hampered by water, but satisfactory progress was now being made; two seams had been proved, from one of which coal was being sold, and it was hoped that a larger output would be secured in a few months. The task of erecting the plant at the new Upton Colliery is proceeding rapidly and satisfactorily. The permanent winding engines are being installed, and a beginning has been made with the sinking of the shafts. The directors of the company believe that in the Upton Collery they have a very valuable proposition. They are erecting modern plant, and carrying everything out on the most up-to-date lines, and the colliery is expected, when fully developed, to yield a large output.

Doncaster Electricity.

In order to meet the estimated cost for electricity distribution works during the next two years, Doncaster Town Council is to apply for sanction to borrow £21,800 for new high-pressure mains, and £24,750 for other mains. It has been decided to make reductions in the charges for electricity supplied to various classes of consumers, including the Tramways Committee, who are to be charged 1d. per unit for their current, instead of 1½d. as at present. At the last meeting of the Council, it was stated that the Tramways Department had made up its mind to expend more money in order to bring the track into a better and more up-to-date condition. The motor omnibus service of the town is to be increased.

NORTH OF ENGLAND.

(From our own Correspondent.)

Better Export Trade.

Although it is difficult to avoid a pessimistic note in regard to the iron and steel trade in the North of England in view of the stoppage of works, some satisfaction may be derived from the fact that the exports from the Cleveland district during March were the best of any month this year. The pig iron shipments totalled 35,915 tons, of which 19,611 tons went abroad and 16,304 tons coastwise, as compared with an aggregate of 27,733 tons in February and 31,186 tons in January. Italy was the largest customer with 5125 tons, while 2768 tons went to Germany, 2645 tons to the United States, 1917 tons to Belgium, and 1274 tons to France. The shipments of manufactured iron and steel were also the highest recorded this year, the March total of 62,086 tons comparing with 54,397 tons in February and 52,749 tons in January. Exports to India showed a considerable improvement, totalling 11,726 tons. South Africa received 5966 tons; Kenya, 4711 tons; Netherlands, 4133 tons; Australia, 4177 tons; and the Argentine Republic 2143 tons.

Iron and Steel Imports.

The effect of foreign competition in the iron and steel trade is reflected in the statistics of the quantities imported to the river Tees from Holland, Belgium, France, Norway, Sweden, Germany and India for the five months ending March 31st as compared with the same months a year ago and the corresponding pre-war period of 1913–14. Pig iron brought in to the end of March last totalled 6497 tons, as against 7738 tons a year ago, and 54 tons in the pre-war period. Crude sheet bars, billets, blooms, slabs, &c., imported in the last five months reached 58,596 tons, as compared with 27,096 tons a year ago, and 19,970 tons in the pre-war period. Plates, bars, angles, rails, sheets, &c., unloaded to the end of March totalled 10,113 tons, as against 6520 tons a year ago, and 11,242 tons in the pre-war period.

Cleveland Iron Trade.

A slightly better tone prevails in the Cleveland iron trade. Home business still rules on very quiet lines, but there is rather more inquiry for export, and there are hopes that the overseas trade will continue to expand, as is usually the case at this period of the year. The statistical position remains fairly healthy, makers being well sold and having light stocks, but some difficulty is experienced in maintaining prices. No. 1 foundry iron is 82s. 6d.; No. 3 G.M.B. Cleveland, 77s. 6d.; No. 4 foundry, 76s. 6d.; and No. 4 forge, 75s. 6d.

Hematite Pig Iron.

Little change is noticeable in the East Coast hematite pig iron trade. Supplies are abundant, but slow of sale. Prospects of substantial curtailment of output have not strengthened the situation at all. Producers are keen to negotiate, and quotations vary considerably. Round about 83s. might be given as the market quotation for mixed numbers, but customers claim that they can purchase at 1s. per ton below that price, whilst there are makers who hold out for and report that they are getting rather more than the figure named.

Ironmaking Materials.

Although fairly heavy imports are being received under running contracts, business in foreign ore is almost at a standstill. Best Rubio ore is quoted at 22s. per ton *c.i.f.* Tees. Business in coke is quieter, good Durham furnace kinds being easy at 23s. per ton delivered at the works.

Manufactured Iron and Steel.

Conditions in the manufactured iron and steel trade are very disappointing. In nearly all departments lean order books are reported, and contracts in hand are fast approaching completion. At some works machinery is kept in motion only on contracts made week by week, and fear is entertained that more plant will have to be laid idle unless an unexpected change for the better occurs. Galvanised sheet producers are the only manufacturers really busy. They report heavy sales and quotations are stiffening.

The Coal Trade.

Some improvement is to be noted this week in the Northern coal trade, but it is entirely due to the near approach of the Easter holidays. There have been a few more inquiries for cargoes for prompt shipment, and these have brought rather better prices than have been quoted within the last few weeks. This is considered to be a mere transient phase of the market, however, and must not be relied upon as indicating any real betterment. Considerable interest has been taken in the contract of the Norwegian Railways for 110,000 tons. Durham's share is 50,000 tons, at prices ranging from 18s. 2d. to 18s. 4d. per ton f.o.b. for best qualities. Of this quantity 35,000 tons are to be shipped up to the end of May, and the remainder from June to September. A Newcastle merchant has secured the contract, and some disappointment has been caused at Northumberland sorts being entirely passed over, for it is believed that the balance of the contract has gone to Spitzbergen, with the exception of 10,000 tons, which have gone to Wales. The coke market remains dull, and new business is very scarce. Wages in the Durham coalfield for April as regulated by the accountants' ascertainment will be over 28 per cent. above the economic state of the industry. The ascertainment shows that but for the national agreement, which fixes the Durham rate at 110 per cent. above the basis, there would have been a reduction from 81.83 per cent. to 81.42 per cent., equivalent to almost a halfpenny per shift.

Cleveland Miners' Wages.

The request of the Cleveland ironstone miners for an advance in wages, apart from the sliding scale, was considered at a joint conference of the mine owners and men's representatives on Monday. The employers regarded the men's request in a sympathetic spirit and acknowledged the sacrifices the men had made to aid in the restoration of the industry. Though they could not hold out any hope that they could accede to the men's request, they asked for time to give the matter full and careful consideration. The question was, therefore, adjourned for a fortnight. In order to bring them once more

into line with the coal miners, the men proposed a return to the seven hours' working day and 46½ hours' week. The employers, however, intimated that they could not make the concession at the present time, as it would tend to increase working costs and make some of the mines unworkable.

SCOTLAND.

(From our own Correspondent.)

The Course of Trade.

On the whole, trade in general has shown few, if any, fluctuations from the course pursued during the past weeks and months, and, as a matter of fact, the depression appears to have intensified. Producers are doing everything possible to avoid a closure, but their efforts are meeting with scant reward. Outputs have been cut down repeatedly in order to keep stocks at a minimum, but, notwithstanding such movements, supplies of many commodities are as easily secured as ever, and at prices distinctly favourable to buyers. Foreign competition is perhaps not quite so keen, but is still heavy enough to compel local manufacturers to discount their prices if they wish to have any chance of success. Recently announced railway contracts for rolling stock have created a bright spot in an otherwise dismal outlook, and though some time must necessarily elapse before specifications are forthcoming, local producers are hopeful that the orders placed in the district will be considerable.

Electric Cranes.

In connection with the railway programme of extension, the London, Midland and Scottish Railway Company has ordered powerful overhead electrically driven cranes for use in the locomotive works at St. Rollox, Glasgow. These cranes, which will have a lifting capacity of 50 tons each, are to be supplied by Sir William Arrol and Co., Ltd., Glasgow.

Pig Iron.

Nothing has occurred to counteract the dulness in the pig iron trade, and makers find that with a minimum number of furnaces working, stocks continue to accumulate. Demands from local steel and ironworks are very far below normal, and export inquiries are not showing any signs of improvement. For home delivery, hematite is quoted at £4 11s., No. 1 foundry £4 10s., and No. 3 foundry £4 9s. per ton delivered Glasgow.

Steel and Iron.

So far as the steel trade is concerned, the position is unchanged. Employment at the rolling mills is irregular. Ship plates and sections have been reduced in price by 5s. per ton, the new quotations being £9 10s. and £9 5s. per ton respectively. The present demand for steel sheets is disappointing, both for light and heavy varieties. The drop in export inquiries is especially disappointing. Sheets are unchanged in price. The bar iron trade is depressing. General demands are still far below normal, and producers are apparently quite confident that an improvement is still a long way off. The re-rolled steel branch of this industry is a shade better off, but exceptionally keen prices have to be conceded in order to obtain even a comparatively small lot. The demand is particularly dull at present.

Coal.

The position in the coal trade is no better; in fact, if anything, the depression is still more acute. For practically all classes of fuel the supply is greatly in excess of the demand, and any buyer with a good prompt order can easily gain a considerable price concession. Many pits are idle and broken time is prevalent where employment is still being maintained. Forward inquiries have been more in evidence, but shippers are securing very little business in competition with Germany and other sources of supply. Lanarkshire splints are almost the only sort to maintain a semblance of firmness, though in Fifeshire and the Lothians washed nuts appear steadier. The latter, however, is chiefly due to a drop in the output of round coal, and not to any increase in business. The home market is weakening. House coal has been reduced by about 1s. per ton. Industrial requirements are exceedingly small, and municipal necessities are becoming less as the season advances.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Position.

Loading activity at the docks this week has been fairly good, and is due entirely to boats arriving for the purpose of enabling exporters to effect shipments earlier than is usual on account of the holidays. Exporters realise that this is a short working month, and consequently have made their arrangements to carry out their commitments as far as possible this side of the vacation, rather than run the risk of waiting until after Easter. On Saturday last there were actually fifteen steamers waiting to get into berth at the various docks, whereas only six empty berths were available, and with fresh arrivals of tonnage over the week-end the collieries have had a very fair supply of tonnage at their disposal. At the same time the amount of fresh business on the market continues to be extremely limited, and for all practical purposes it may be said that business for shipment promptly was concluded last week, so that the market all this week has been very quiet, and a holiday feeling has more or less prevailed. Apart from current business, the Crown Agents for the Colonies, acting for the Administration of Palestine, have invited tenders for 25,000 tons of Welsh steam large coals for delivery to the Palestine Railways, and another inquiry is on behalf of the Buenos Aires Great Southern Railway for three cargoes of 6000 tons each of Monmouthshire large coals.

Coalfield Items.

The situation in the coalfield continues to cause considerable anxiety on account of the amount of unemployment. The records show that there are between 16,000 and 17,000 miners who are altogether unemployed, while thousands of others are only working part time. Unfortunately, it looks very much as if the position may become worse rather than better, judging from the amount of business coming along and the prices that are obtainable. The miners employed at the Abergorchy collieries, Treorchy, numbering about 1000, received notices last Wednesday ending their employment in fourteen days, this being due entirely to the depression in trade. Notices to about 900 men engaged at the Lady Lewis colliery, Ynyshir, expired on Saturday. The management offered to withdraw the notices if the workmen were prepared to accept certain terms, but when the latter were placed before the miners they were rejected. However, the men proposed to meet again this week to consider the matter. On the other hand, there is the welcome news that it has been definitely decided to reopen the Tynewydd colliery, Pontlottyn, in the Rhymney Valley, where previously about 600 men were employed.

Miners' Wages.

The South Wales Miners' Federation has now definitely formulated its policy regarding the new wages agreement. There was a special conference of delegates at Cardiff on Saturday last to consider proposals for the amendment of the existing wages agreement, and at the outset the point was raised whether the present method of regulating wages upon the principle of district profits should be substituted by that of regulating wages by the cost of living. The unanimous decision was come to that the minimum rate of wages payable should be those obtaining in 1914, plus the cost of living percentage, as published by the Board of Trade from time to time. Further, the delegates to the next national conference were instructed to support the proposals that steps should be taken to re-institute the payment of the Sankey award of 2s. per shift for the raising of the general standard of living of miners; that workmen employed by night should have a week of five nights and be paid at the rate of $1^1/_5$ turns for each shift worked; that membership of the Miners' Federation be a condition of employment at the collieries; and that the miners be guaranteed a weekly wage and two weeks' holiday every year with pay.

Reduced Exports.

A statement issued by the Great Western Railway regarding the trade at South Wales ports affords interesting reading, though it is not satisfactory. The total exports from January 1st to March 22nd last amounted to 7,157,331 tons, as against 8,180,569 tons for the same period of last year, and in the case of coal and coke alone there was a falling off during the above-mentioned period of no less than 1,062,832 tons. For the four weeks ended March 22nd the total exports came to 2,384,426 tons, which, compared with the preceding four weeks, was a decline of 206,981 tons, though imports improved by 61,109 tons.

South Wales Docks.

Towards the end of last week the Great Western Railway Company announced that the docks at Swansea, Newport, Barry and Port Talbot would be closed one tide on Sundays, commencing from last Sunday, thus bringing them into line with the practice prevailing at the Cardiff Bute docks and at Penarth. Doubtless this action has been dictated by reasons of economy, and it is understood that the closing is of an experimental character for six months, when the whole position will be reviewed. The action of the company has met with considerable opposition from shipowners, especially so far as Swansea is concerned, it being pointed out that serious delays would result if large boats were unable to dock, owing to the fact that there is only one main entrance to the three big docks at that port, viz., the King's, The Queen's and the Prince of Wales' docks. In deference to the wishes of the trade, the Great Western Railway Company agreed therefore to defer introducing the arrangement at Swansea for the time being.

Slackness in Tin-plate Trade.

The industrial position at Llanelly continues to be very unsatisfactory, and about 4000 to 5000 men employed in the tin-plate trade are idle. The workmen, numbering about 400, engaged at the works of the Glanmor Engineering Company, Ltd., which is the largest undertaking of this description in West Wales, have received a week's notice. This does not necessarily mean that the works will suspend operations, but this step has been taken as a precautionary measure owing to the unsettled state of trade.

Current Business.

The tone of the steam coal market has been exceedingly quiet all this week, and very little business has been carried through. Most buyers have completed their arrangements for supplies for loading immediately before and after the holidays, and they have been concentrating their efforts upon getting tonnage away before the vacation. Prices exhibit no material alteration, and show some unevenness, despite the fact that shipments during the past week have been more active than for several weeks past. The miners in this district will for the most part follow their practice of working on Good Friday, but the first three days of next week will be holidays.

LAUNCHES AND TRIAL TRIPS.

Shirley T. Taylor, steamer; built by Earle's Shipbuilding and Engineering Company, Ltd.; to the order of the Eastern Steamship Company, Ltd.; dimensions, 258ft. by 44ft. by 20ft. Engines, triple-expansion, surface-condensing, 17in., 28in., 46in. by 33in. stroke, pressure 180 lb.; constructed by the builders; launch, March 21st.

Atlantic, single-screw motor tanker; built by Sir W. G. Armstrong, Whitworth and Co., Ltd., to the order of A/S Dampskibsselskabet "Atlantic," Norway; dimensions, 455ft. by 57ft. 2in. by 33ft. 11in.; to carry 10,300 tons. Engines, single-screw engine of the Armstrong-Sulzer Diesel type; constructed by the builders; launch, March 24th.

City of Delhi, steamer; built by Wm. Gray and Co., Ltd., to the order of Ellerman Lines, Ltd.; dimensions, 469ft. by 59ft. 7in. by 34ft. 9in.; 7600 gross tonnage. Engines, balanced quadruple surface-condensing, 24in., 35in., 51in., 74in. by 51in. stroke, pressure 250 lb.; constructed by the builders; launch, March 24th.

Inverlago, twin-screw vessel; built by Harland and Wolff, Ltd., to the order of Andrew Weir and Co.; dimensions, 315ft. by 50ft. broad; to carry 2360 gross tonnage. Engines, twin-screw, triple-expansion; constructed by the builders; delivered, March 24th.

Roebuck, twin-screw steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Great Western Railway Company; dimensions, 210ft. by 33ft. 6in. beam; to carry 600 tons deadweight. Engines, triple-expansion; constructed by the builders; launch, March 24th.

Alynbank, twin-screw motor vessel; built by Harland and Wolff, Ltd., to the order of Andrew Weir and Co., Ltd.; dimensions, 434ft. by 53ft. 9in. by 37ft.; 5200 gross tonnage. Engines, two sets of six-cylinder Diesel; constructed by the builders; trial trip, March 26th.

Crested Eagle, paddle passenger steamer; built by J. Samuel White and Co., Ltd., to the order of the General Steam Navigation Company, Ltd.; dimensions, 309ft. 3in. by 68ft. 10in. by 11ft. 6in.; to carry 1650 passengers. Engines, surface condensing, triple-expansion, diagonal paddle, 30in., 46in., 69½in. by 66in. stroke, pressure 180 lb.; constructed by the builders; launch, March 26th.

Inverrosa, oil vessel; built by Harland and Wolff, Ltd., to the order of Andrew Weir and Co., Ltd.; dimensions, 315ft. by 50ft. broad; to carry 2360 gross tonnage. Engines, twin-screw, triple-expansion, pressure 180 lb.; constructed by the builders; launch, March 26th.

Rawalpindi, twin-screw passenger liner; built by Harland and Wolff, Ltd., to the order of the Peninsular and Oriental Steam Navigation Company; dimensions, 570ft. by 71ft. by 47ft. 6in. Engines, two sets of quadruple-expansion, pressure 215 lb.; constructed by the builders; launch, March 26th.

No. 608, single-screw motor ship; built by Barclay, Curle and Co., Ltd.; dimensions, 410ft. by 55ft. 3in. by 29ft.; 6500 gross tonnage. Engines, three, 24½in. diameter by 44in. stroke, constructed by the North British Diesel Engine Works (1922), Ltd.; launch, March 31st.

John A. Holloway, steamer; built by Earle's Shipbuilding and Engineering Company, Ltd.; to the order of the Eastern Steamship Company, Ltd.; dimensions, 258ft. by 44ft. by 20ft.; 2510 tons deadweight. Engines, triple-expansion, surface-condensing, 17in., 28in., 46in. by 33in. stroke, pressure 180 lb.; constructed by the builders; trial trip, April 1st.

CATALOGUES.

Hick, Hargreaves and Co., Limited, Soho Ironworks, Bolton.—Catalogue on steam turbines.

Lobnitz and Co., Limited, Renfrew, Scotland.—Bulletin No. 104, describing the Lobnitz dragline excavator.

The Stanton Ironworks Company, Limited, near Nottingham.—Monthly list of cast iron pipes in stock.

Bruce Peebles and Co., Limited, Edinburgh.—Pamphlet No. 13 D, dealing with the Peebles open type alternating-current generators.

The Clyno Engineering Company (1922), Limited, Wolverhampton.—Booklet illustrating and describing the "New Regent" saloon car.

R. W. Crabtree and Sons, Limited, 7, Farringdon-road, E.C. 1.—Special catalogue No. 2, illustrating and describing the "Crabtree" printing press.

Swan, Hunter and Wigham Richardson, Limited, Wallsend-on-Tyne.—Booklet entitled "Oil Tank Ships," containing a map of the world's oil depôts.

The English Electric Company, Limited, Queen's House, Kingsway, W.C. 2.—Publication No. 570, entitled "Geared Steam Turbo-generator Sets."

Luth and Rosen Electric Company, Limited, 75, Victoria-street, S.W. 1.—Catalogue entitled "What we can do," illustrating and describing the manufactures of the company.

The Underfeed Stoker Company, Limited, Aldwych House, Aldwych, W.C. 2.—Copy of a paper by W. J. Cotterell entitled "Pulverised Fuel and its Application to Boiler Firing."

J. and R. Fleming, Limited, 146, Clerkenwell-road, E.C. 1.—Catalogue entitled "Industrial Head and Eye Protection," illustrating and describing various kinds of goggles and masks.

The Riley Stoker Company, Limited, Palace Chambers, Bridge-street, S.W. 1.—Catalogue "B," describing the Riley stoker with multiple retorts and the Jones stoker for small unit boilers.

The Mirrlees-Watson Company, Limited, Scotland-street, Glasgow.—Publication S800, on the list of parts for the Mirrlees-Watson cane mill machinery. Pamphlet No. Pu. 780, illustrating and describing the Mirrlees bore-hole pump. Pamphlet No. S 600, entitled "The Cultivation of Castor Seed;" No. S 60, "Meineck Patent Intermediate Carriers between Cane Mills;" and No. S 350, "The Regulation of Multiple Effect Evaporators."

Journal of the Royal Technical College, Glasgow.—We have received a copy of the first number of the official journal of the Royal Technical College, Glasgow. This journal has been founded to provide a means of publishing in a collected form accounts of some of the research work in applied science undertaken by the teaching staff and by post-graduate and research scholarship students. The first number makes an excellent start with accounts of eleven different researches and investigations. Two of the papers are of direct engineering interest, namely, Professors Mellanby and Kerr's account of their study of the pipe loss in steam turbines and Professor Kerr's description of his research on turbine wheel friction. The remaining contributions are of chemical, physical and metallurgical interest. One of the non-engineering papers deals with the separation of the components of petroleum. In it, Dr. P. F. Gordon suggests that the petroleum industry has not fully availed itself of the great advances in chemical science made during the past fifty years, and that in concentrating upon the fuel and lubricant aspect, it has neglected the possible development of a large chemical industry analogous to that founded on the chemistry of coal-tar. The journal is published at 5s., on behalf of the College, by Mr. Robert Anderson, 142, West Nile-street, Glasgow.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	17/6 to 24/-
(1) Spanish	21/-
1) N. African	21/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	22/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	4 11 6	—
No. 1 Foundry	4 10 6	—
No. 3 Foundry	4 8 0	—
N.E. Coast—		
Hematite Mixed Nos.	4 3 0	4 3 0
No. 1	4 3 6	4 3 6
Cleveland—		
No. 1	4 2 6	4 2 6
Silicious Iron	4 2 6	4 2 6
No. 3 G.M.B.	3 17 6	3 17 6
No. 4 Foundry	3 16 6	3 16 6
No. 4 Forge	3 15 6	3 15 6
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
,, ,, Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	3 12 6 to 3 14 0	
,, Forge	3 8 0 to 3 9 0	
(3) Derbyshire—		
No. 3 Foundry	3 17 0 to 3 18 0	
Forge	3 13 0	—
(3) Lincolnshire—		
No. 3 Foundry	4 2 6	—
No. 4 Forge	3 17 6	—
Basic	4 0 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 16 0 (a) / 4 18 6 (b) / 5 5 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	12 0 0	—
Best ,,	—	—
N.E. Coast—		
Common Bars	12 0 0	—
Lancs.—		
Crown Bars	13 0 0	—
Second Quality Bars	12 0 0	—
Hoops	15 0 0	14 15 0
S. Yorks.—		
Crown Bars	13 0 0	—
Best ,,	13 10 0	—
Hoops	14 10 0	—
Midlands—		
Crown Bars	12 15 0	—
Marked Bars (Staffs.)	15 0 0	—
Nut and Bolt Bars	11 15 0	—
Gas Tube Strip	13 0 0 to 13 2 6	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	13 0 0	—
Ship Plates, ½in. and up	9 10 0	—
Sections	9 5 0	—
Steel Sheets, 3/16in. to ½in.	11 0 0	—
Sheets (Gal. Cor. 24 B.G.)	—	£17 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 17 6	—
Angles	8 12 6	—
Boiler Plates	13 0 0	—
Joists	8 12 6	—
Heavy Rails	9 0 0	—
Fish-plates	13 10 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	9 10 0	—
Soft Billets	8 10 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 15 0†	—
Light ,,	9 0 0 to 9 5 0	
Billets	8 0 0 to 11 0 0†	
Manchester—		
Bars (Round)	9 15 0 to 10 0 0	
,, (others)	9 10 0 to 9 15 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	13 15 0	13 10 0
Plates	9 15 0	—
,, (Lancs. Boiler)	13 0 0	—
Sheffield—		
Siemens Acid Billets	11 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	9 10 0	—
Intermediate Basic	9 0 0	—
Soft Basic	8 0 0 to 8 5 0	
Hoops	12 0 0	—
Soft Wire Rods	9 10 0 to 11 0 0	
Midlands—		
Small Rolled Bars	8 15 0 to 9 15 0	
Billets and Sheet-bars	7 0 0 to 7 10 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	16 10 0	—
Angles	8 15 0 to 9 0	
Joists	8 13 0 to 9 0 0	
Tees	9 15 0 to 10 0 0	
Bridge and Tank Plates	9 15 0	—
Boiler Plates	13 10 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	22/1½ to 22/6
Block Tin (cash)	232 0 0
,, (three months)	235 5 0
Copper (cash)	60 7 6
,, (three months)	61 10 0
Spanish Lead (cash)	32 17 6
,, (three months)	31 15 0
Spelter (cash)	34 11 3
,, (three months)	33 11 3
Manchester—	
Copper, Best Selected Ingots	64 15 0
,, Electrolytic	65 15 0
,, Strong Sheets	90 0 0
,, Tubes (Basis Price)	0 1 1
Brass Tubes (Basis price)	0 0 11½
,, Condenser	0 1 2
Lead, English	35 10 0
,, Foreign	34 5 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/9 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	8/-
,, 6 p.c. to 8 p.c. ,,	£23 10 0	7/9
,, 8 p.c. to 10 p.c. ,,	£23 0 0	7/6
,, Specially Refined		
,, Max. 2 p.c. carbon	£42 10 0	16/-
,, ,, 1 p.c. ,,	£52 0 0	17/-
,, ,, 0.75 p.c. carbon	£58 0 0	19/-
,, ,, carbon free	1/5 per lb.	
Metallic Chromium	4/- per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 10 0 scale 5/- per unit	
,, ,, 75 p.c.	£20 5 0 scale 6/- per unit	
,, Vanadium	17/- per lb	
,, Molybdenum	7/3 per lb.	
,, Titanium (carbon free)	1/- per lb.	
Nickel (per ton)	£175	
Cobalt	10/3 per lb.	
Aluminium (per ton)	£130	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	16/6
,, ,, Ell	17/9
,, ,, Splint	18/9 to 22/-
,, ,, Trebles	15/-
,, ,, Doubles	14/-
,, ,, Singles	13/6
Ayrshire—	
(f.o.b. Ports)—Steam	16/6
,, ,, Splints	18/9
,, ,, Trebles	15/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	14/1½ to 16/3
Screened Navigation	22/3
Trebles	15/3
Doubles	14/6
Singles	13
Lothians—	
(f.o.b. Leith)—Best Steam	16/-
Secondary Steam	15/3
Trebles	16/-
Doubles	14/6
Singles	13/6

ENGLAND.

	Inland.
(8) N.W. Coast—	
Steams	28/-
Household	45/- to 58/4
Coke	28/6
Northumberland—	
Best Steams	16/9 to 17/6
Second Steams	16/6
Steam Smalls	11/-
Unscreened	15/6 to 16/6
Household	23/6 to 25/-
Durham—	
Best Gas	19/6 to 20/-
Second	17/- to 17/6
Household	23/6 to 25/-
Foundry Coke	21/6 to 22/6
Sheffield—	Inland.
Best Hand-picked Branch	30/- to 33/- —
Barnsley Best Silkstone	26/- to 28/- —
Derbyshire Best Brights	28/- to 31/- —
,, ,, House	24/- to 26/- —
,, ,, Large Nuts	20/- to 24/- —
,, ,, Small	14/- to 16/- —
Yorkshire Hards	18/- to 22/- —
Derbyshire ,,	18/6 to 22/- —
Rough Slacks	10/- to 12/6 —
Nutty ,,	8/6 to 10/- —
Smalls	4/- to 6/6 —
Blast-furnace Coke (Inland)*	— —
,, ,, (Export)	f.o.b. 21/3 to 22/3

(9) SOUTH WALES.

Cardiff—	
Steam Coals :	
Best Smokeless Large	26/- to 26/6
Second ,, ,,	25/- to 26/-
Best Dry Large	25/- to 25/6
Ordinary Dry Large	23/6 to 24/6
Best Black Vein Large	24/- to 24/6
Western Valley ,,	23/- to 24/-
Best Eastern Valley Large	23/- to 24/-
Ordinary ,, ,,	22/6 to 23/-
Best Steam Smalls	15/6 to 16/3
Ordinary ,,	13/- to 15/-
Washed Nuts	20/- to 28/-
No. 3 Rhondda Large	27/- to 27/6
,, ,, Smalls	17/- to 18/-
No. 2 ,, Large	22/- to 22/6
,, ,, Through	18/- to 20/-
,, ,, Smalls	12/- to 13/6
Foundry Coke (export)	40/- to 47/6
Furnace Coke (export)	25/- to 30/-
Patent Fuel	23/- to 26/6
Pitwood (ex ship)	24/- to 24/6
Swansea—	
Anthracite Coals :	
Best Big Vein Large	43/- to 45/-
Seconds	37/6 to 40/-
Red Vein	29/- to 32/-
Machine-made Cobbles	50/- to 55/-
Nuts	50/- to 55/-
Beans	42/6 to 45/-
Peas	21/- to 23/6
Breaker Duff	8/9 to 9/3
Rubbly Culm	11/6 to 12/-
Steam Coals :	
Large	22/- to 24/-
Seconds	21/- to 22/-
Smalls	10/- to 13/-
Cargo Through	16/- to 19/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.
(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast-furnaces only, 16/9, with fluctuations according to analysis; open market, 18/- to 19/- at ovens. † Latest quotations available. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham.

French Engineering Notes.

(*From our Correspondent in Paris.*)

Trade Difficulties.

THE industrial situation has been going from bad to worse through the influence of the present Socialist legislation, which has had the effect of increasing enormously the discount rates, and thereby depriving manufacturers of their usual facilities for doing business, and of rarefying capital by the many expedients which have been adopted for getting hold of as much of it as possible. The threatened burdens on capital and industry are of so repressive a character that both are now waiting anxiously to see what will be the fate of the measures incorporated in the new Budget. Until then it is evident that nothing can be done. The seriousness of the situation was observable in the financial incidents of the past week, when the Government announced that there would be a further fiduciary inflation which it declares is to be undertaken solely in the interests of commerce and industry. Now that the State proposes to tax industry up to the hilt, it hopes to provide industry with the means of paying those taxes. At the same time it is proposed to make an entirely new issue of banknotes to replace the existing paper with the idea of bringing into circulation the money which is being hoarded. If capital were left alone there would be nothing like the hoarding that is taking place now. When money does not circulate there can be no buying and no business, and no Government can compel money to circulate by threats and arbitrary measures. On the top of this the Government proposes to double the existing taxes on capital. The effect of the present financial policy is to create a feeling of serious uneasiness amongst commercial and industrial classes, which feeling seems to be justified by the steady fall of the franc and by the appreciation of values generally. The only activity is in the building trades. Everywhere else business is stagnant, and yet there are plenty of elements of recovery if only confidence could be restored.

Exports.

If business is hampered in this country by the efforts to impose heavy burdens on commerce and industry, the further depreciation of the franc has had the effect of turning attention to the export trade. Of late the currency depreciation has had a less marked influence than formerly upon the foreign demand for French products, but the continued decline of the franc has apparently reached a point at which foreign buyers find it to their interest to place orders here. Especially is this the case with metallurgical products. During the first two months of the year the quantity of iron ore sent away was 1,856,206 tons, principally to Germany, Holland and Belgium. In pig iron the exports during February showed a big decline as compared with the previous month, but the total for the two months reached 103,048 tons. The chief customers were Belgium, Italy and Switzerland. Billets, blooms and bars amounted to 295,763 tons. One of the largest customers was Great Britain, and some consignments were made to the United States. There was also a growing activity in rails which totalled 35,047 tons for the two months, and here again Belgium and Luxemburg were the principal buyers, while fair quantities were sent to Japan and the United States. A feature of the returns is the evidence they convey of the increasing United States' purchases, which confirm the general impression that the export business is facilitated by the monetary depreciation.

Arsenals.

In voting the Budget estimates the Senate has made a nominal reduction in the amount allotted for naval construction with the idea of drawing the attention of the Government to the necessity of presenting its proposal to reform the arsenals without further delay. Of the five arsenals the previous Government had decided to suppress three, leaving only Toulon and Brest, which were to have been maintained with a reduced staff. It was argued that as the arsenals absorbed nearly one half of the total budget of the marine, and as they employed nearly 20,000 men and four times as many engineers as in the British arsenals, all of whom had to be paid when there was no work for them to do, it would be far more economical to suppress these State establishments and have the vessels constructed in private shipyards. The present Socialist Cabinet, however, has decided upon maintaining the arsenals on the plea that they are necessary to check shipbuilders' prices. The arsenals are to be reorganised on industrial lines, although the opponents of the Socialist reform object that no good can come from any attempt to industralise State institutions. The Minister of the Marine declares that he will keep Toulon and Brest in full working order. Cherbourg and Bizerta will serve as naval bases. Shipbuilding will be carried on at Lorient, which the Minister declares has one of the best dry docks in the world, and Rochefort will be equipped principally for the construction of mines. In the belief that the scheme can only result in waste and extravagance it is certain that when the Government presents its project for the maintenance of the arsenals it will meet with strong opposition in the Senate.

Aviation Engines.

For more than a year past tests have been carried out with aviation engines under the conditions of a trial organised by the Sous-Secrétariat de l'Aéronautique which obtained credits to be distributed as prizes amounting to 2,000,000 f. The engines were to develop from 350 horse-power to 450 horse-power with a maximum weight of 3.3 kilos.—just over 7¼ lb.—per horse-power, including fuel and lubricating oil for five hours' running. The competition comprised a bench test of five hours and a flying test of two hours, and the engines coming successfully through this eliminating trial were to be subjected to bench tests of eight hours' continuous running for a total period of 240 hours. Of the thirteen engines entered eight only were presented at the trials and three were subsequently withdrawn. The engines remaining are a Lorraine-Dietrich, a Panhard and two Renaults. No time limit is fixed for the competition, which is likely to be protracted, especially in view of the large proportion of bench test failures which do not count in the total.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics

When an abridgment is not illustrated the Specification is without drawings.

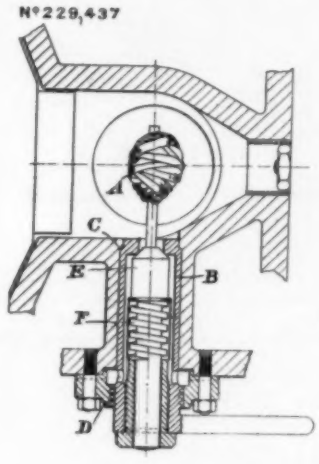
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

229,437. December 22nd, 1923.—STARTING HIGH-COMPRESSION ENGINES, G. M. Blackstone, F. Carter, and E. Carter, Rutland Engineering Works, Stamford, Lincs.

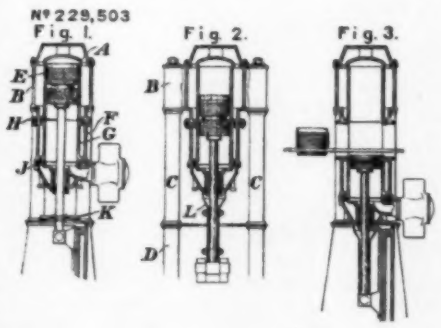
This device is intended for starting high-compression oil engines when compressed air is not available. It is of the type in which a piece of smouldering cotton waste is used to ignite



the charge. The waste A is bound on a rod fixed in the plug B, which makes a gas-tight joint with the cylinder casting at C. The plug is forced up against this seat by the interrupted screw D, so that it can be quickly inserted while the cotton waste continues to smoulder after being lighted. E is a relief valve working against a spring F.—*February 26th*, 1925.

229,503. March 11th, 1924.—PISTONS OF DOUBLE-ACTING ENGINES, G. J. Lugt, No. 66, de Lairessestraat, Amsterdam.

In this engine the upper part A of the cylinder is secured by bolts to the frame beam B, which is supported by means of columns C from the crank case columns D. The beam B also serves as a water jacket. The lower end of the upper cylinder barrel part E slidably fits in the beam B, so as to have freedom of axial expansion therein. The lower part F of the cylinder jacket, which encloses the lower barrel part G, is secured by bolts to a flange H on the beam B. Secured to the lower jacket part F is the bottom cylinder cover J, which is provided with the stuffing-box for the piston-rod and with a passage leading to a combustion chamber. The crank case is closed at its upper

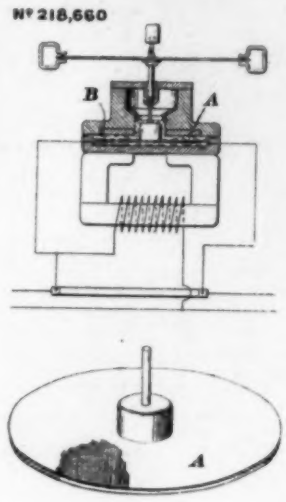


sides by a horizontal plate and by a cover K composed of two halves. When it is desired to inspect or remove the piston, the engine is turned until the piston-rod is in the position shown in Fig. 2. Thereupon a sleeve L, composed of two halves, is placed around the piston-rod so as to rest with its bottom edge upon the crosshead, its upper edge serving to support the bottom cylinder cover when the bolts have been removed. Further turning of the engine causes the piston and the lower cylinder part F G to descend together until the latter rests on the top cover plate of the crank case—see Fig. 3. The piston is now in its lower dead centre position and its upper part has completely moved out of the top cylinder part, so that it may be inspected or removed.—*February 26th*, 1925.

ELECTRICAL APPLIANCES.

218,660. July 2nd, 1924.—IMPROVEMENTS IN AND RELATING TO ELECTRIC METERS, *The British Thomson-Houston Company, Ltd., Crown House, Aldwych, W.C.* 2.

This invention relates particularly to an improved process for treating the rotor of an electric meter so that the useful life of the rotor may be materially increased. The usual copper punched rotor disc is first cleaned and then subjected to a slow copper-plating process, which requires about 20 minutes. This forms a very smooth, compact, chemically pure copper surface, which completely covers the rotor. In the lower illustration the copper-plated surface is represented at A, and a portion is shown untreated in order to indicate the difference in surface in the two instances. An ordinary copper rotor contains impurities, and if they are covered up by an ordinary amalgamated surface, they continue to react with the mercury of the meter chamber after the meter has been put into use, and slowly but continually change the resistance of the rotor as more mercury penetrates into the copper punching. As shown in the upper illustration, the rotor A is completely immersed in

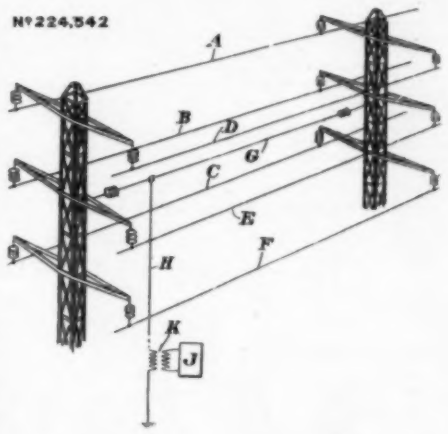


mercury B, and current is conveyed to and from the mercury chamber by leads.—*February 26th*, 1925.

TELEGRAPHS AND TELEPHONES.

224,542. November 6th, 1924.—IMPROVEMENTS IN HIGH-FREQUENCY ELECTRIC SIGNALLING SYSTEMS, *The British Thomson-Houston Company, of Crown House, Aldwych, W.C.* 2.

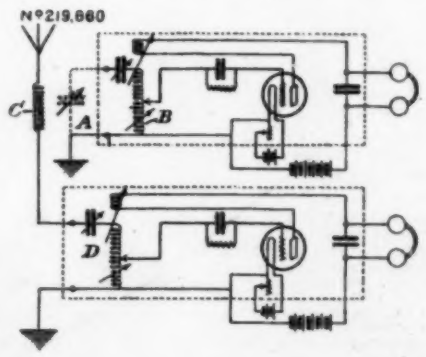
The high-tension transmission system shown in the diagram consists of six wires, A B, C D and E F for two three-phase



lines. The coupling wire for the communication system is shown at G. A lead H connects the coupling wire with a signalling apparatus J, through a coupling transformer K, the signalling apparatus being either a transmitter or receiver. The coupling wire, it will be noticed, is surrounded by the transmission lines.—*February 26th*, 1925.

219,660. June 20th, 1924.—IMPROVEMENTS IN OR RELATING TO WIRELESS RECEIVING APPARATUS, *Marconi's Wireless Telegraph Company, of Marconi House, Strand, W.C.* 2.

Two regenerative receivers of the single circuit type operate on the same antenna circuit, as shown. One of these receiving circuits—the upper one in the diagram—is not directly connected to the antenna, but a variable condenser A is connected across the coil B, and to earth. The variable condenser A is set so that its capacity is the same as that of the aerial. When using the apparatus the lower receiver is adjusted to give maximum signal intensity in the usual manner, care being taken to adjust



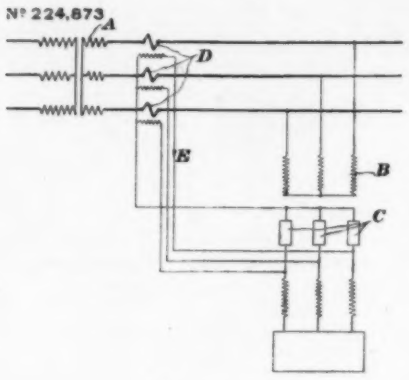
the coupling of the feed-back circuit almost to the point where oscillations are set up. The other receiver is then similarly adjusted, first with moderately close coupling between the coils C and D, and then with very loose coupling. It is then found that the apparatus will not only provide an exceptional degree of selectivity and discrimination between stations of different wave lengths, but that it will give a remarkably increased volume in the headphones or loud speaker associated with the upper receiver. While a coupling coil C is shown, it is frequently unnecessary to use such a coil. If the coil B of the upper receiver be placed in inductive relation to the lead in wire from the antenna to the lower receiver, sufficient energy will be

transferred to the upper receiver to permit of operation of the apparatus. With this combination of circuits the regenerative action of the lower receiver lowers the effective antenna resistance and thereby increases the signal voltage. Similarly, the regenerative action of the other receiver increases the selectivity of its associated tuning system, and the combination of the two provides selectivity and signal audibility which cannot be obtained from either receiver alone. Other schemes are shown which have been found to provide exceptional amplification of reception for great distances, and in these cases two high-frequency valves are used in the upper receiver.—*March 5th*, 1925.

MEASURING AND TESTING INSTRUMENTS.

224,873. October 13th, 1924.—Measuring High Voltage from the Low-voltage Side of Load Transformers. *The International General Electric Company, of* 120, *Broadway, New York, U.S.A.*

According to this invention, the load transformer is used as the voltage converter for measuring purposes, and the error in the ratio of transformation caused by the transformer load is compensated. A is the load transformer the high voltage of which is to be measured. It transforms the pressure to an inter-

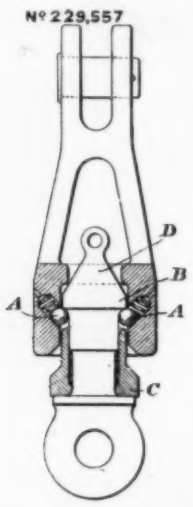


mediate voltage, with which the measuring instruments and relays are not directly connected, but are connected through a voltage converter B. In each phase of this voltage converter impedances C are connected. Current flows through these impedances from the current transformer D. This current is proportional to the load, and it produces a voltage in the impedances proportional to this current, and therefore to the voltage drop in the main transformer. This voltage is added geometrically to the low voltage of the measuring converter, so that the resultant voltage is at all loads proportional to the high voltage of the main transformer.—*February 26th*, 1925.

CRANES AND CONVEYORS.

229,557. July 7th, 1924.—Detachable Rope Couplings. Nydqvist and Holm Aktiebolag, Eskilstuna, Sweden.

This coupling is primarily intended for use in connection with boat-lowering gear. The two parts are locked together for

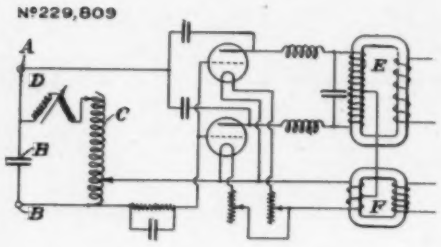


carrying the load by the balls A A, which are pressed by springs under the shoulder B of the lower part. When it is desired to uncouple the sleeve, C is pushed up and the balls are forced back into recesses. An eye D is provided for a guide line to facilitate recoupling.—*February 26th*, 1925.

MACHINE TOOLS AND SHOP APPLIANCES.

229,809. December 31st, 1923.—Improvements in or relating to Electric Induction, Heating Apparatus, particularly for Smelting Purposes, Electrical Improvements, Ld., of Milburn House, Newcastle-on-Tyne, and Lewis Colin Grant, of Wandsworth House, Heaton, Newcastle-on-Tyne.

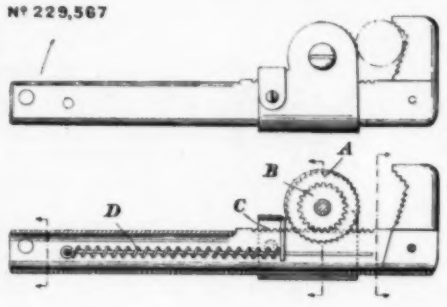
A thermionic valve or other electrical circuit is employed by the inventors to generate the currents supplied to an induction coil for heating purposes. In the accompanying diagram, A and B are the output terminals, which are connected to a tuning circuit B, C and D, the latter being a variometer. The frequency of the oscillations generated by the thermionic valve can therefore be adjusted to the desired value. The two banks of valves are fed through transformers E F from a common source of alternating-current supply. When the filaments are lighted and the high-tension supply is applied to the anodes, the anode potential will rise and will cause a current to flow through the coil C and the valves. This causes flux and potential variations in the circuit, which are reflected on the grid circuits of the valves, so that the anode and grid circuits operate differentially. An alternating or oscillating current is thus generated, the frequency of which is dependent upon the time constant of the tuning coil C and the tuning condenser B. Another scheme is described, which involves the



use of two electro-magnetically coupled coils instead of the single coil C.—*March 5th*, 1925.

229,567. July 22nd, 1924.—Wrenches, F. Moore, Corner Braddock-avenue and Forbes-street, Pittsburg, Penn.

In this pipe wrench one of the gripping jaws takes the form of a ratchet wheel A, which is connected with a pinion B that meshes with a rack C cut on the shank of the tool. A spring D



is provided to press the movable jaw up against the work. It will be seen that the pressure on the ratchet wheel tends to increase its grip. Shrouds are arranged outside the wheel to prevent its teeth from biting too far into the work.—*February 26th*, 1925.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the time and place *at which the meeting is to be held should be clearly stated.*

WEDNESDAY, APRIL 15th.

Institution of Automobile Engineers.—Chamber of Commerce, New-street, Birmingham. Birmingham Graduates' meeting. Paper, "High-speed Motor-cycle Engine Valve Gears," by Mr. A. Weatherstone. 7.30 p.m.

THURSDAY, APRIL 16th.

Institute of Metals: London Local Section.—Institute of Marine Engineers, 85/88, The Minories, Tower Hill, London, E. 1. Paper, "Metals in the Gaseous State," by Mr. C. H. M. Jenkins. 7.30 p.m.

FRIDAY, APRIL 17th.

Diesel Engine Users' Association.—The Engineers' Club, Coventry-street, London. W. 1. Paper, "Recent Oil-engine Developments," by Mr. J. L. Chaloner. 3.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, Westminster, London, S.W. 1. Paper, "Vertical Retorts," by Mr. W. T. Dunn. 7.30 p.m.

SATURDAY, APRIL 18th.

Institute of British Foundrymen: Lancashire Branch, Junior Section.—College of Technology, Manchester. Lecture on "Foundry Materials," by Mr. A. Hill. 7 p.m.

MONDAY, APRIL 20th.

Institution of Automobile Engineers: Birmingham Centre.—Chamber of Commerce, New-street, Birmingham. Paper, "Brakes for Motor Vehicles," by Mr. G. W. Watson. 7 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Howard Lecture, "Motor Fuels—I.," by Professor John S. S. Brame. 8 p.m.

TUESDAY, APRIL 21st.

Institution of Automobile Engineers.—The Broadgate Café, Coventry. Coventry Graduates' meeting. Paper, "Designing Rear Axles for Production," by Mr. C. Burrows. 7.15 p.m.

Institution of Electrical Engineers: North Midland Students' Section.—The University, Leeds. Address by the chairman, Mr. T. B. Johnson. 7 p.m.

Institution of Engineers and Shipbuilders in Scotland.—39, Elmbank-crescent, Glasgow. Annual general meeting. Paper, "Aerodynamics of the Rotating Cylinder," by Mr. Alexander Thom. 7.30 p.m.

Newcomen Society.—University College, Gower-street, London, W. 1. Papers, "Glass-making in Egypt," by Sir Flinders Petrie; "Chiddingfold Glass and its Makers in the Middle Ages," by Mrs. Brenda C. Halahan; "The Interrelationship of the Glassmakers in Western Europe," and "Glass-making under the Roman Empire," by Mr. E. W. Hulme. 5 p.m.

WEDNESDAY, APRIL 22nd.

Institution of Automobile Engineers: North of England Centre.—Milton Hall, 244, Deansgate, Manchester. Paper, "Brakes for Motor Vehicles," by Mr. G. W. Watson. 6.30 p.m.

Institution of Electrical Engineers: North Midland Students' Section.—Visit to the works of the Metropolitan-Vickers Electrical Company, Ltd., Trafford Park, Manchester.

THURSDAY, APRIL 23rd.

Institution of Automobile Engineers.—Watergate House, Adelphi, London, W.C. 2. London Graduates' meeting. Lecture, "Modern Machine Tool Methods," by Messrs. Buck and Hickman. 7.30 p.m.

Institution of Automobile Engineers.—Training School of Vauxhall Motors, Ld., Luton. Luton Graduates' meeting. Paper, "Supercharging," by Mr. P. H. Goffey. 7.30 p.m.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, London, W.C. 2. "Recent Improvements in the Insulation of Electrical Machinery," by Lieut.-Colonel K. G. Maxwell and Mr. A. Monkhouse. 6 p.m.

FRIDAY, APRIL 24th.

Institute of Metals: Sheffield Local Section.—Mappin Hall, Department of Applied Science, The University, St. George's-square, Sheffield. Paper, "Chromium Plating," by Mr. Byron Carr. 7.30 p.m.

Institute of Metals: Swansea Local Section.—Metallurgical Department of the University College, Singleton Park, Swansea. Annual general meeting. 7.15 p.m.

MONDAY, APRIL 27th.

Institution of Automobile Engineers: Scottish Centre.—Royal Technical College, Glasgow. Paper, "The Accessibility of the Pleasure Car Chassis," by Mr. M. Platt. 7.30 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Howard Lecture, "Motor Fuels—II.," by Professor John S. S. Brame. 8 p.m.

TUESDAY, APRIL 28th.

Institute of Marine Engineers.—85–88, The Minories, Tower-hill, London, E. 1. "Steam Accumulation," by Mr. D. M. Proctor. 6.30 p.m.

Institute of Metals: North-East Coast Local Section.—Electrical Engineering Theatre, Armstrong College, Newcastle-on-Tyne. Annual general meeting. 7.30 p.m.

Institution of Automobile Engineers.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "The Accessibility of the Pleasure Car Chassis," by Mr. M. Platt. 7 p.m.

Institution of Electrical Engineers: North Midland Centre.—Hotel Metropole, King-street, Leeds. Annual general meeting and smoking concert. 6.45 p.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

The Wagner Electric Corporation, of St. Louis, Missouri, asks us to announce the appointment of J. A. Gelzer, as sales manager of the automotive division of the company.

The Vickers-Spearing Boiler Co., Ltd., 20, Kingsway, London, W.C. 2, asks us to announce that it has a set of lantern slides illustrating various types of water-tube boilers and chain grate stokers, which it will be pleased to lend to anyone giving lectures on the above subjects.

CONTRACTS.

The Leeds Forge Company, Ltd., of Leeds, has received an order from the Crown Agents for the Colonies for one hundred all-steel bogie covered goods wagons for the Uganda Railway.

The Westinghouse Brake and Saxby Signal Company, Ltd., has received an order from the Holmside and Southmoor Collieries, Ltd., for a complete interlocked electro-pneumatic decking plant at its Morrison Busty pits, both pit top and pit bottom.

An important contract has just been placed with Walter Jones and Sons, of Westminster, for a portion of the Watford Road in the Mill Hill district. Over 100,000 cubic yards of extra filling and about 70,000 cubic yards of excavation are involved in this section, which is about 2 miles long.

Edgar Allen and Co., Ltd., of Sheffield, have recently received orders for:—(1) A complete cement manufacturing plant, of a capacity of 110,000 tons per annum, including electric motor equipment for the Dunstable Portland Cement Company, Ltd.; and (2) a complete cement manufacturing plant for the Standard Portland Cement Company, Ltd., New South Wales, with a capacity of 100,000 tons per annum. Other contracts in hand and nearing completion are those for:—(1) A complete Portland cement manufacturing plant, with a total capacity of 90,000 tons per annum, for the Sulphide Corporation, Ltd., Cockle Creek, New South Wales; (2) a complete Portland cement manufacturing plant, of a capacity of 60,000 tons, for the Gillingham Portland Cement Company, Ltd., Kent; and (3) four rotary furnace units for the reduction of copper ore, for the Bwana M'Kubwa Copper Company, Ltd., Northern Rhodesia.

Open Exhibitions in Engineering.—The Council of the University College of Southampton has decided to award two open entrance exhibitions in engineering to candidates who may or may not be now resident in the district. The awards will be made on the recommendation of the Engineering Faculty Board without formal examination, provided the candidates have matriculated and are prepared to read for a degree in engineering.

V.D.I. Meetings in Augsburg.—The annual meetings of the Society of German Engineers will take place in May this year at Augsburg. A feature of the meeting will be the inspection of a collection of models and drawings relating to early developments in connection with water power and pumps used in and about the city. Several examples of the practice of the fifteenth to the eighteenth century will be shown. According to historical records, the first water-driven mills in Augsburg were planned about the year 1276. In 1761 there were over sixty mills of various types in operation in and around Augsburg. Another section of the exhibition will be devoted to specimens of work from various trades schools, which will illustrate the method employed for training apprentices.